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Ban on Foreign Circulation of Marine Engineering

ON July 5 a general order regarding permits to carry plans and specifications of ships, shipyards, dry docks, and the like out of the United States was issued by Howard Coonley, vice-president, U. S. Shipping Board Emergency Fleet Corporation, as follows:

"Hereafter permits to carry out of the United States photographs, prints or other reproductions of plans or specifications of shipyards, ways, dry docks or ships or of their parts or equipment will not be granted or authorized by or in the name of the United States Shipping Board Emergency Fleet Corporation except to officials of or representatives of the United States.

"The Secretary of the Treasury has been requested to issue orders to the collectors of the various ports to confiscate any such plans or specifications found in the possession of persons leaving this ountry."

As every issue of MARINE ENGINEERING contains information of the kind which the above order prohibits sending out of the country, it is probable that future issues of the magazine will not reach our subscribers who reside outside of the United States. Steps have been taken to have this order so modified that the magazine can be sent to subscribers in the countries allied with us in the war against Germany, but at the time of going to press no action has been secured in this matter, and, until further notice, the publication of the above order will explain the non-delivery of copies of MARINE ENGINEERING to foreign subscribers.

"All Hail, American Shipbuilders!"

"NO more defiant answer could be given to the enemy's challenge," said General Pershing, in cabling the congratulations and thanks of the army in France to American shipbuilders for their splendid achievement in launching on July 4 ninety-five vessels, aggregating 476,164 deadweight tons. General Pershing's cablegram was as follows:

"The launching of one hundred ships on the Fourth of July was the most inspiring news that has come to us. All ranks of the Army in France send their congratulations and heartfelt thanks to their patriotic brothers in the shipyards at home. No more defiant answer could be given to the enemy's challenge. With such backing we cannot fail to win. All hail, American shipbuilders!"

While a few years ago the possibility of such a record would have been looked upon as miraculous, nevertheless this performance was not in any sense a miracle. It was the result of hard work by an army of patriotic American workmen, loyal to the cause for which the nation is fighting and inspired by the determination to spare no efforts in making the world safe for democracy.

The vessels launched on July 4 included forty-two steel vessels of 278,464 deadweight tons and fifty-three wood vessels of 188,700 deadweight tons. At the Union Iron Works in San Francisco, four merchant ships and eight torpedo boat destroyers were launched and there were triple launchings at the Ecorse plant of the Great Lakes Engineering Works, the Newark Bay plant of the Submarine Boat Corporation, the L. H. Shattuck yard Newington, N. H., the Newport News Shipbuilding yard at Newport News, Va., and the Moore shipbuilding plant at San Francisco. Seventeen war vessels, including fourteen destroyers, were also launched on the same day.

In addition to the Fourth of July launchings, there were many other notable achievements recorded during the month. The United States destroyer *Ward,* which was launched eighty-four percent complete at the Mare Island Navy Yard, San Francisco, seventeen and one-half days after her keel was laid, was put into commission seventy days after the laying of the keel. The first of the *Eagle* boats, building at the Ford plant in Detroit, was launched on July 11, and the novel methods of construction which have been developed for building this class of vessels will make it possible hereafter to launch these vessels at the rate of one a day. At the Ecorse (Mich.) plant of the Great Lakes Engineering Works, a 3,500-ton steel vessel has been launched fourteen days after its keel was laid. These and similar records prove that the shipbuilding resources of the country will not be found wanting.

Naval Architects' Annual Meeting

ACCORDING to an announcement recently issued by the secretary of the Society of Naval Architects and Marine Engineers, the annual meeting of the society this year will be held on November 14 and 15 in the Engineering Societies Building, New York City, with the annual banquet on the evening of the 15th at the Waldorf-Astoria Hotel. This will be the twenty-sixth annual meeting of the society, and, owing to the tremendous growth of the shipbuilding industry in this country and the importance of its bearing on the outcome of the war, the programme will be of particular significance. As the membership of the society comprises most of the men who are in charge of shipbuilding operations throughout the country, the meeting, if well attended, will give a splendid opportunity for the interchange of ideas and a comparison of methods for speeding up the production in the shipyards.

Papers have been promised dealing with the design and construction of concrete ships, wooden ships, structural steel standardized cargo vessels, unsinkable ships and experiments upon simplified forms of vessels. An opportunity for a thorough discussion of the new methods of shipbuilding, which have been introduced primarily as a war measure, will be given by the presentation of papers on the great assembling plant at Hog Island and the Ford

plant at Detroit. Other papers will deal with electric welding, geared turbines, notes on launching ways, side launchings, floating dry docks, shipyard tools, electric auxiliaries, hull vibration and similar topics. In addition to this, it should not be forgotten that this year junior members of the society will be expected to contribute papers for discussion. For the best paper from a junior member a prize of $100 (20/16/8) has been offered by H. L. Aldrich, member of council of the society and publisher of this journal.

Taken from every standpoint, the meeting will be a notable one, as it will reflect what American naval architects and shipbuilders are accomplishing in the most momentous period of their history.

University Training in Merchant Marine Administration and Operation

IN order to meet the demand for a body of trained men to supply the organization for the direction of the growing American merchant marine and to prepare for competition after the war, a course in the principles of merchant marine administration and operation will be included in the curriculum of the New York University next fall. The course will be given two nights a week at the Wall Street division of the university by William H. Brittain, secretary of the American Steamship Association. A similar course, it is understood, will also be given at the College of the City of New York.

While shipping men look upon practical experience as an essential in rounding out any course of training for the merchant marine, nevertheless it is universally agreed that much can be done through teaching at the universities. The element of time requires that action should be taken immediately, so that at the end of the war the United States will not be caught unprepared. The course at New York University will cover a wide range and include such topics as marine underwriting, ship and freight brokerage, Admiralty law, international law affecting shipping and ship operation, rates and rate structure, government relation to shipping, etc. Judging from the results obtained from the course in marine insurance, which was inaugurated at New York University last year, for which there were four hundred applicants, the new course will attract an even larger number of students and furnish a most valuable aid in building up the American merchant marine.

Industrial Housing Construction

IN his introduction to the report recently made to the American Concrete Institute by its committee on Industrial Concrete Houses, the chairman, Mr. Leslie H. Allen, of the Aberthaw Construction Company, of Boston, alluded particularly to the relation of labor turnover to the suitability and adequacy of the housing.

The housing programme of the Government entrusted to the Shipping Board and the Department of Labor will set the standard of housing for many years to come. It is of the utmost importance that these standards should be higher than the low standards that now prevail and especially that the work done be of such permanent character that it may prove to be an adequate security for the expended funds and for long-term mortgage bonds at low rates of interest.

The concrete house is now an accomplished fact. It has come to stay. For many years experiments have been made with many types, many of the earlier houses were quite unsuitable and showed defects, but the later examples are much improved, the earlier defects are being eliminated and the concrete house, as built to-day, is a thoroughly sanitary, weatherproof, permanent and fireproof home. It approaches more nearly the ideal home than any other type of construction.

Good and sufficient housing is one of the most pressing needs of the nation at this time. Without it we are seriously handicapped in winning the war. The provision of good housing is not only an immediate need but a permanent national gain, and every one who lends his influence and aid to the securing of this end is rendering a real service to the nation.

The Alien Enemy Act

IN order that there may be no misunderstanding regarding the purposes of the Alien Enemy Act, Mr. A. Mitchel Palmer, custodian of alien enemy property, has issued, through the Editorial Conference of the New York Business Publishers' Association, Inc., a statement outlining the scope of this Act and the duties of the custodian of alien enemy property. As this Act has a direct bearing on the marine as well as other industries, we direct special attention to Mr. Palmer's statement, which follows:

There are two ways of making war against an enemy. One by force of arms; the other by force of economic pressure.

When a nation wages economic war it brings to bear upon the enemy every force it can muster to stop his supply of food, money and munitions and thereby make him weak and impoverished.

The day the United States entered the war there was in this country millions upon millions of dollars belonging to Germans. It was invested in mines, factories, banks, steamships, farms, plantations, etc., etc. Its total amount might run into billions. We had no way of estimating them. But we did know that it was German gold that was colonizing industries here in America and that it was good American money that was being shipped back to Berlin in the form of earnings to enrich the German nation, to fill its war chests, to help complete its great plan for a world control of commerce and industry.

When war was declared, the Army and Navy started to mobilize men and guns, the Shipping Board to build the fleet: the War Trade Board to cut all commercial relations with the enemy, and the Alien Property Custodian to gather into the Treasury of the United States every penny of German-owned money that could be found. That is why the office of the Alien Property Custodian was created.

The duties of the Alien Property Custodian are exactly what the name implies, only, in addition to the work of taking over and administering holdings of enemies, he has been given power by Congress to sell outright those properties belonging to the great industrial and corporation classes of Germany planted here in America.

In order to help it is important to know just *who* is an "enemy" and *what* is "enemy" property.

Enemy property includes any and every kind of property, money, chattels, securities, lands, indebtedness, accounts receivable, etc., which belongs to an enemy. Even if the property is held in the name of another—by a dummy or in trust—if the real beneficial interest belongs to an enemy, it is enemy property.

An enemy under the Act is:

1. Any person, regardless of citizenship or place of birth, which is within the boundaries of Germany, Austria-Hungary, or their allies, or within the territory actually occupied by their military or naval forces. A peaceful and law-abiding German or Austrian citizen residing in the United States is not an enemy; but an American citizen living in enemy territory is an enemy.

2. A person residing outside of the United States and doing business within the territory of enemy countries or their allies.

3. A corporation, if incorporated within the territory of enemies or their allies, or incorporated in any neutral country and doing business within the territory of enemies or their allies.

4. An official or agent of an enemy Government or any subdivision thereof.

5. All natives, citizens, or subjects of Germany or Austria-Hungary interned by the War Department.

6. All citizens or subjects of Germany or Austria-Hungary resident outside of the United States who are (a) wives of officers, officials or agents of Germany or Austria-Hungary, wherever resident; (b) wives of persons within the territory (including that occupied by military and naval forces) of Germany or Austria-Hungary; or (c) wives of persons resident outside the United States and doing business within enemy territory.

7. Citizens or subjects of Germany or Austria-Hungary who are prisoners of war or who have been or shall be interned by any nation associated with the United States in the war.

8. Citizens or subjects of Germany or Austria-Hungary who since April 6, 1917, have disseminated or shall hereafter disseminate propaganda to aid any enemy nation or to injure the cause of the United States, or who have assisted, or who shall assist in plotting against the United States or any nation associated with the United States in the war.

9. Citizens or subjects of Germany or Austria-Hungary who are included or who shall be included in the "Enemy Trading List" published by the War Trade Board.

10. Citizens or subjects of Germany or Austria-Hungary who, at any time since August 4, 1914, have been resident within enemy territory.

Note: Numbers 2, 6, 8, 9 and 10 apply only to persons resident outside of the United States.

Three-quarters of a billion dollars' worth of property have been reported to the Alien Property Custodian at Washington to-day, but from our investigation throughout the country we know that there is much more not yet located. Here is where the citizens can render valuable assistance.

You can help the nation by mailing the Bureau of Investigation, Alien Property Custodian, Washington, D. C., reports or information on enemy-owned property in your vicinity. You are shareholders in this great combination trust company, department store, and auction sale, now run by the government, and the larger you swell its holdings the more you will back up the Army and Navy now battling against the Hun.

American Classification for American Ships

THE article entitled "American Classification for American Ships," by Winthrop L. Marvin, published in the April issue of Marine Engineering, pages 206 to 210, has brought out a great deal of violent criticism, particularly on the part of certain English publications. Apparently the writers of these criticisms speak from the standpoint of prejudice rather than of actual knowledge.

Mr. Marvin's article was gracefully written and intended to be a club stuffed with straw. If spikes had been put in the club, the article would have stated the case somewhat as follows:

Before the American Bureau of Shipping was organized under its present officials, American shipping interests are alleged to have practically offered to turn over the classing of American vessels to a British organization with the distinct understanding that plans and specifications should be passed upon in this country instead of sending them across the ocean and waiting weeks and oftentimes months for them to be passed upon. Experience had shown that even when plans have been passed upon, decisions have been revoked by cable, thus seriously interfering with the construction of the vessels in this country.

American shipping interests apparently offered to meet the British interests more than half way, but, instead of the offer being received in the spirit in which it was made, complete and abject surrender was demanded, putting entire control of the designing of American vessels into certain hands in London.

This did not appeal to the American shipping interests, and, as a consequence, the American Bureau of Shipping was brought up to the splendid basis upon which it rests to-day. The question of standing by our ally has nothing whatever to do with the classing of vessels. The only point at issue was whether or not American shipping interests were willing to submit to complete and abject surrender to a British demand or stand on their own rights and design their ships as best suited American needs.

LETTER TO THE EDITOR

An American Prerogative

No recent decision of the United States Shipping Board has been more gratifying to American shipowners and builders than the frank preference given in Washington to the American Bureau of Shipping in the survey and classification of merchant ships contracted for this year by the government. This is in logical harmony with the general policy of the Board as now constituted, to develop our new merchant marine on foundations that are distinctively American and permanent.

As was anticipated, there has been an effort on the part of injudicious friends of the British Lloyd's Register to twist this wholly natural preference for the American society into an unfriendly act toward an ally, but this is camouflage by which no open-eyed man can be deceived. The most important work which the British Lloyd's surveyors came here for was in connection with certain craft ordered some time ago, before we entered the war, by British and Scandinavian concerns, backed quite possibly by the British government. But since these ships have been taken over by our own government, there is no further need of or pretext for the employment of a very thoroughgoing British institution for the survey and classification of ships built for and owned by the American nation—a service for which a competent and strengthening American society is already in existence.

Incidentally, it may be said, in a spirit of friendly admonition, that the British Lloyd's Registry has scarcely commended itself to further American favor by the bitter personal attacks in certain British maritime journals on those American citizens who have advocated the policy of preference for American interests. Nor would it prove very advantageous if an American classification society in a similar case were to maintain in London a lobbyist at a salary higher than was paid to its trained engineers.

To choose the American Bureau of Shipping for the vital work of surveying and classifying the new American merchant steamers is the natural exercise of an act of national sovereignty, any external interference with or external criticism of which is most certain to arouse vigorous resentment.

Boston, Mass. Winthrop L. Marvin.

Schwab's Fourth of July Address to the Shipyard Workers in San Francisco

Director-General of the Emergency Fleet Corporation Urges the Men to Speed Up Shipbuilding—Recognition Promised for Production Records

SOME of the finest records, perhaps the very finest, of shipbuilding achievements made since we entered this war, have been scored on the Pacific Coast. Every man in every shipyard in America is performing a very necessary and very patriotic service. It will go farther, perhaps, toward winning the war than any other service short of the fighting on the battlefields of France. Building ships is the first job that must be done if we are to overcome the menace of the submarine. In building these ships and in building them as well and fast as they can be built you are answering the call of America.

Fourth of July Launchings Greatest in History of the World

While the returns from the shipyards are not yet in, I venture to predict that the number of ships launched on July 4 is the greatest record of launchings for a single day in the history of the world. When the truth percolates to the German people they will know that their leaders have deceived them; that Americans have their sleeves rolled up and we have our fighting blood up; that we are going to win this war if it takes the last man, the last ounce of strength, the last resource and the last dollar that this country possesses.

All shipbuilders have dedicated their service to America. At last we in this country have come to realize our true position, and we stand firm, determined and unafraid before the naked truth that we must defeat Germany or Germany will defeat us. We have to go over the top in the shipyards just as the United States Marines went over the top at Chateau Thierry in France. That is the kind of fighting spirit that is making our shipbuilding a success. I find it everywhere in the shipyards.

Germany Feels the Blow

Wars are not won altogether on the battlefield. News of America's accomplishments in the shipyards causes almost as much consternation in Germany as actual defeat. Do not think for one minute that the Prussian generals are unmoved by what we are accomplishing. They know that we launched a 5500-ton ship in 27 days from the time the keel was laid over in Camden, N. J. That was a tremendous accomplishment never before approached in any country and it was a blow in the face of Prussian confidence. Our enemy knows, too, that it is the workmen over here who are making these things possible; that the men in the shipyards are working day and night, determined, untiring and enthusiastic; that they are backing up the boys in the trenches. The Kaiser knows that with the united backing of American workmen, American armies can never be beaten. The credit for winning this war will be shared equally by the workmen of America and the fighters of America.

It was in the West that speed records were first made in the shipyards. Before the war began it took from six months to a year to build the largest types of steel ships, but the Pacific Coast cut down this time to 90 days and then to 55 days. It is men like Dave Rodgers, at the Skinner & Eddy plant, and Joe Tynan at the Union Iron Works—men who know their jobs and treat their men squarely—on whom the Government relies for the right leadership in this shipbuilding programme.

Rivet Heater Boy a Young Hero

The best captains and colonels in our shipbuilding army, however, cannot build ships without the strong armies of the privates, corporals and sergeants. The heater boy to-day is a young hero who deserves a place alongside the drummer boy in that picture seen so often—"The Spirit of '76."

I had a telegram recently telling me how Burt Myers, a riveter and his gang in the Long Beach Shipbuilding Company's yard, drove 2,137 seven-eighth-inch flush rivets in a shell in eight hours. That kind of a day's work, made by steady workmen and translated into high averages, puts ships into the water in record-breaking time.

It is the high average, of course, that is the best gage of shipbuilding temperature. It is the worker who stays on the job even at the cost of pride and personal sacrifice that counts for America and against Germany. The man who forgets his own troubles, who thinks only of his country, is the kind of man who is needed in American shipyards to-day

Army of 300,000 Shipyard Workers

We have a great army of workers building ships for this emergency. There are 300,000 of us, and we are all fighting for America. You men who swing the cranes are in charge of the big guns. You who drive the rivets are operating the machine guns of the shipyard. Every man who does a full day's work is doing his share to win the war. The gangs at work on a ship are holding a trench and when they launch that ship they go over the top. When they lay a new keel they are digging in and making ready for another long defense.

German submarines appeared recently off the Atlantic Coast, trying to crowd us off the ocean highways. That was no new thing for Germany. Prussian officers in German cities crowd civilians off the pavements when they stride through the streets. Americans are not the oppressed tired people the Germans are. Americans know their rights and will fight for them. They wont be crowded off the streets or off the ocean highways. Germany's purpose in sending submarines to American waters was to cow this great nation into inaction and to paralyze our preparations. Germany has failed in her purpose. The loss of a few ships may sting but it only goads us on to harder fighting.

Fruitlessness of German Submarine Raid

Every time we launch a cargo or troop ship or tanker we add to the certainty that German submarines cannot win this war. Already we have the U-boats on the run, and if we keep up the pace we will have them beaten by next year. And when we achieve this victory it will be you who will deserve the credit. So far as I am concerned, and so far as Mr. Hurely is concerned, and I am sure so far as the President of the United States is concerned, you will get the credit.

Now what did this German raid on American shipping

really amount to? These scavengers of the sea began their activities on May 25 and we continued to hear from them up to June 15. In that time they had sunk 10 American vessels of 26,000 deadweight tons. These were mostly small ships, unarmed and of no great consequence in the winning of the war. In the same period of time, from May 25 to June 15, American shipyards completed and delivered to the United States Shipping Board 30 vessels, ranging from 3,500 to 10,500 deadweight, and aggregating 167,000 deadweight tons. Place 30 ships of 167,000 tons against 10 ships of 26,000 tons and you can see how much this terrible submarine raid amounted to.

These figures are correct. It will take more than an occasional submarine raid off our coasts to make the American shipbuilder throw up his hands and cry, "Kamerad!"

Germany's only hope now, if it can be called a hope, is to win this war by great military victories. Germany knows that we are building ships and getting a real army across the Atlantic. The Kaiser is making his supreme effort now in the knowledge that America will soon be started and will stay in the war until it is won. If we complete our shipbuilding programme they will know over in Germany that not a shred of hope remains. Can we complete it? Can we build these ships in time to keep our bridge to France unbroken? That is a question for you men in the shipyards to answer. America has never lost a war and she is not going to lose this one.

Building Ships Faster than Submarine Can Destroy Them

To-day we are building ships faster than the submarine can destroy them. Meanwhile, our Navy is destroying submarines. The German hordes may make some advances on the Western front, but are we downhearted? No. Our army in France and our shipbuilding army at home are getting into their full stride and we will whip them if it takes everything we have.

We must get the men and the guns and the airships over. More and more men must go over, and more guns and rifles and motor trucks—rails, clothing, and horses—but the whole job depends upon you. I, for one, have every confidence that you will do the job and do it right.

There is a glory in this war that will belong to you and you alone. I know that when you are working in the shipyards, wet with heat, tired, you have in your minds a picture of a ship completed—strong, durable, powerful. You can picture also the stevedores loading that vessel in an American port, American soldiers going aboard, a sharp, swift encounter with a submarine, the safe arrival at a war port on the other side, and the joy of Pershing and his men. With every arrival of new troops or more food, ammunition, guns and clothing you put heart into the boys in the trenches. That is a privilege and a glory that belongs to you and can belong to no one but the shipbuilders of America.

Vast Growth of American Shipbuilding

Now you wonder, naturally, how your work has counted. Let me tell you. In 1915 all the shipyards in America turned out 215,602 deadweight tons of shipping. The next year when the demand for ships in foreign countries became so great that every existing yard in America entered into keen competition for foreign contracts, our output jumped to 520,847 tons, or almost double the total for 1915. In 1917 the hot pace continued until we very nearly doubled the output of the previous year, completing a total of 901,223. We thought we were building ships, with almost a million deadweight tons of finished vessels, but I am confident now that if we pull together and every man stays on the job, we will produce more than 3,000,000 deadweight tons in 1918—the greatest output of any nation in the world in a single year.

It is a record of which any industry and any nation may well be proud. Last year I would not have said it was possible to do much more in 1918 than double last year's output because we had done fairly well, considering our facilities, when we produced 901,223 tons in 1917; but I am convinced now that the spirit that actuates the men in the yards, with the enthusiasm that lightens our task and with the determination to win out that is a part of every true American to-day, we will have more than trebled the output of last year when we get through with 1918.

Our shipbuilding programme is coming along. We are now just getting into our stride. I think that we can point with some pride to May of this year, when we not merely launched but completed 263,000 tons of shipping—more than was turned out in the entire year of 1915. This has been made possible by the enlistment of the whole-hearted support of every industry engaged in any part of the shipbuilding job. If we can build 263,000 tons of ships in one month when some of our yards are not yet completed and when we are still training men to build ships, think of the vast possibilities in the years to come. We Americans must replace the shipping that the war has taken. It is a stupendous task. Five years ago, if you had been told that this country would produce 263,000 tons of shipping in a single month, you would not have believed it, but that is a mere beginning of the task that lies before you men in the shipyards.

Marvelous Shipyard at Hog Island

You have heard something about the big Hog Island Shipbuilding plant outside of Philadelphia. That plant has 50 ways. It is a world's fair in itself and nothing like it has ever been dreamed of in the shipbuilding industry. It has acres and acres of shops, miles upon miles of railroad lines. It is the working place of 35,000 toilers. Hog Island presented a problem that could only be solved by Herculean effort, and this required courage. It was an undertaking that no nation in the world except America would have ventured upon, but we are going to put it through.

They have been delayed down at Hog Island in getting their fabricated steel, but we are not going to have that trouble in the future, because we have made arrangements for the construction of two big fabricating steel plants to add to the output of 67 plants already engaged in fabricating work. More than half the ways of Hog Island now are occupied by hulls. Before long they will begin shoving these ships into the water and Admiral Bowles, who has charge of this work, tells me when Hog Island gets into full swing there will be a launching there every other day.

The shipbuilders on the Great Lakes will produce between 400,000 and 500,000 tons this year, and they are preparing to double their output next year. A fine spirit of co-operation is in evidence in the yards along the Lakes and I have every reason to believe that they will carry a full share of the burden.

I have to make good in this job. I never had a more important job or a more serious one. I want to make good but I can't do it unless you can make good in your job. I am an optimist by nature. I always feel that our goal should be set a little higher than what we expect to accomplish and then if we strive to reach the goal with

all our energy and enthusiasm, why we will reach the goal and pass it.

I want to give you some of the enthusiasm that I feel about this shipbuilding enterprise. I believe it cannot fail and if I can make you believe that and work at your job with the same energy that I expect to put into my job then I know it cannot fail.

There is one thing that we need if we hope to reach our maximum capacity of production and that is a friendly rivalry between the yards. I have tried to encourage that because I know that competition is dear to American hearts and I know that you will respond to a challenge.

Government Recognition for Exceptional Services

Now we are going to recognize a shipyard that surpasses all others in actual production each month. A blue flag which this yard will be authorized to fly on its flagstaff will be a mark of national recognition. It will be in the shipbuilding field what an award for distinguished service is on a battlefield.

There is a board at Washington composed of men who know the science of shipbuilding, headed by Rear Admiral Fletcher, which will determine the winners in this great national contest between shipyards. This board will consider every factor in the progress of the various yards not only in awarding the blue flag for first place but also the white and red flags which are to be presented for second and third place. Any yard which holds first place for three consecutive months will have signal honors, for it will be authorized to fly this championship blue pennant permanently from its flagstaff.

Service Badges for Shipyard Workers

Now there are many men in the shipyards who feel a sense of embarrassment because, with their country at war and Liberty in danger, they are not in the uniform of the Army or the Navy. I want to say that these men, if they are shipbuilders, and belong in the yards, are entitled to just as much recognition and just as much honor as the brave boys on the sea or in the trenches. And it is to give you shipyard workers such recognition that the Government has determined upon the awarding of service badges to the men who give four months' faithful service to the Government in the shipyards at building ships, and bars for additional length of service. With these service badges you can walk through the crowds, meet the boys of the Navy and the Army and hold your heads high. To sacrifice one's life for one's country is, of course, the supreme sacrifice, but in this war the highest duty is to serve where your Government tells you to serve.

We are going to give special gold and silver medals for unusual service in the shipyards. We feel that there should be some way of recognizing the man who does a great thing for his country in war time. Great things are being done to-day in the shipyards. Every one of you has a chance to win honors in this great fight in the American shipyards against the submarines—a battle of construction against destruction.

The Government appreciates what you men, and the men in other yards on the Pacific Coast, are achieving in the great struggle of America to maintain the independence that was won so many years ago. Because of my long association with you, I feel that I can ask you, perhaps more freely than I can ask others, to put every ounce of your strength and energy into the task of building ships for America. There is nothing that I will not sacrifice to help in winning this war, and I know that there is nothing you will not sacrifice. Put punch in your work and we'll put over the programme. If you stand up to your job, we'll make the Kaiser take his medicine lying down.

Barge Model Built of Concrete to Test New Type of Construction

A navigable barge model has been built of concrete by the Newton Engineering Company, Milwaukee, Wis., according to designs by George C. Newton, vice-president of the company. It has a length of sixteen feet, beam of forty inches, and molded depth of twenty inches. The concrete skin is only three-quarters inch thick, being supported at intervals by fabricated concrete frames. The vessel has a draft light of seven and one-half inches and a total displacement of about two tons.

In its construction a concrete keelson and keel, together with one row of longitudinal girders midway between the keelson and bilge, were cast integral with the skin. The concrete deck extends for three feet at the bow and two feet at the stern, together with a short section in connection with a concrete bulkhead amidships. The lines of the model are those of a cargo-carrying barge for canal use.

This boat was built primarily to test out certain construction methods and features of design involved in the Newton system of concrete ship construction. Among the objects sought were the securing of a comparatively thin concrete skin, a special design of reinforcement for all torsional, reverse, and longitudinal stresses, as well as those due to the direct water and cargo pressures. The Newton system also aims primarily to secure a practical method of concrete ship construction following the existing system for fabricating steel ships, and one which will permit the use of forms for a number of times for standardized ship sections. Incidentally it is claimed that great speed can be secured with this method of ship construction, due to the use of many parts fabricated in advance.

An interesting feature of the construction of this boat was that all the methods used in its building were exactly those that will be used for large ships. No difficulty was encountered in securing very good results in pouring the three-quarter inch thickness of concrete between forms for the skin.

For testing it out under power a three and one-half horsepower Evinrude row-boat motor is used. With this motor a speed of from four to five miles per hour is secured, with practically no vibration.

Norway's Merchant Marine in March, 1918

The statistics published by the Norwegian Department of Trade and Commerce concerning the Norwegian merchant marine in March, 1918, show that the net result for the month was a decrease of five vessels, with a total of 33,626 tons. On March 1, 1918, there were in the Norwegian merchant marine 3,260 vessels of 1,998,174 tons. During the month there were 34 vessels of 46,906 tons removed from the list of vessels, and 29 vessels of 13,280 tons were added, the net result being as stated above. On April 1, 1918, there were 3,255 vessels of 1,964,548 tons in the Norwegian merchant marine.

Of the ships removed from the list, 19, with a tonnage of 34,994 tons, were lost through operations of war. Of the vessels added to the list, 8 of 7,940 tons were built in Norway, this in addition to 17 motor boats of 1,400 tons. Four motor vessels were purchased abroad.

Ships Under Construction in the United States Total Nearly 14,000,000 Tons

Reports from Emergency Fleet Corporation Show 157 Shipyards with 834 Ways Have Under Contract 1,977 Ships of 13,718,850 Deadweight Tons

ACCORDING to recent reports from the Emergency Fleet Corporation there are now in operation in the United States 157 shipyards, containing 834 ways. The total number of vessels under contract is 1,977, aggregating 13,718,850 deadweight tons.

The following list of shipyards, together with the number of shipways in each, the ships under contract and the deadweight tonnage, is reprinted, without verification, from the *Journal of Commerce and Commercial Bulletin* of New York City of July 11:

DISTRICT No. 1—NEW ENGLAND STATES

WOODEN VESSELS

Shipbuilding and Yard Location	Shipways	Ships Under Contract	D.W. Tons
Portland Ship Ceiling Co., Portland, Me.	3	6	3,500
*G. A. Gilchrist, Thomaston, Me.	1	1	3,500
Cumberland Shipbuilding Co., Portland, Me.	4	9	3,500
L. H. Shattuck, Inc., Portsmouth, N. H.	12	18	3,500
Freeport Shipbuilding Co., South Freeport, Me.	2	4	3,500
*The Kelley Spear Co., Bath, Me.	3	1	3,500
Sandy Point Shipbldg. Corp'n, Sandy Point, Me.	2	2	8,500
*Crowninshield Shipbuilding Corp'n, South Somerset, Mass.	8	6	Tugs

STEEL VESSELS

Groton Iron Works, Groton, Conn.	6	6	8,800
		6	9,400
Atlantic Corporation, Portsmouth, N. H.	5	10	8,800
*Bethlehem Shipbuilding Corp'n, Ltd., (Fore River Shipbuilding Corp'n), Quincy, Mass.	†18	3	9,100
		6	9,400
*Texas Shipbuilding Co., Bath, Me.	‡7	13	9,250

† Four building for U. S. Navy. ‡ Three building for private parties.

DISTRICT No. 2—NEW YORK AND EASTERN NEW JERSEY

WOODEN VESSELS

The Foundation Co., Passaic River, Newark	5	10	3,500
*Groton Iron Works, Noank, Conn.	6	12	3,500
Ship Const. & Trading Co., Stonington, Conn.	2	2	3,500
Traylor Shipbldg. Corp., Cornwells Heights, Pa.	10	10	3,500
*Gildersleeve Ship Construction Co., Gildersleeve, Conn.	2	2	3,500
Kingston Shipbldg. Co., Rondout Creek, Kings.	3	4	3,500
*Johnson Shipyard Corp., Mariners Harbor, N.Y.	3	3	3,500
Housatonic Shipbldg. Co., Inc., Stratford, Conn.	6	6	3,500

STEEL VESSELS

Downey Shipbuilding Corp'n, Milliken, Richmond Borough, N. Y.	4	10	7,500
Newburgh Shipyards, Inc., Newburgh, N. Y.	4	10	9,000
Federal Shipbldg. Co., Hackensack River, N. J.	10	30	9,600
		4	5,000
Bayles Shipyard, Inc., Pt. Jefferson, L.I., N.Y.	2	2	Tugs
*Bethlehem Shipbuilding Corp'n, Ltd., (S. L. Moore Plant), Elizabeth, N. J.	5	20	Tugs
		3	3,930
*Standard Shipbldg. Co., Shooters Island, N. Y.	†6	10	7,433
		13	7,300
*Staten Island Shipbuilding Co., Port Richmond, N. Y.	‡4	5	3,500
*Providence Eng. Corp'n, City Island, N. Y.		10	Tugs
Submarine Boat Corp'n, Newark, N. J.	28	150	5,000

† One for private owners. ‡ Two for private owners.

DISTRICT No. 3—CHESAPEAKE BAY

WOODEN VESSELS

Maryland Shipbuilding Co., Sollers Point, Md.	4	6	3,500
Newcomb Lifeboat Co., Hampton, Va.	4	4	3,500
Henry Smith & Sons Co., Baltimore, Md.	4	8	3,500
Potomac Shipbuilding Co., Quantico, Va.	4	7	3,500
York River Shipbuilding Corp'n, West Point, Va.	4	8	3,500
*M. M. Davis & Son, Inc., Solomons, Md.		8	Tugs

STEEL VESSELS

		7	Mine Sweepers
		8	8,800
*Baltimore D.D. & Shipbldg. Co., Baltimore, Md.	4	12	10,300
		6	6,000
	†4	8	6,240
Virginia Shipbuilding Corp'n, Alexandria, Va.	4	12	9,400
*Virginia Shipbuilding Corp'n, Wilmington, Del.		6	7,500
*Harlan & Hollingsworth	5	12	5,850
*Bethlehem Shipb'g Corp'n, Sparrows Point, Md.	7	9	12,000
		4	7,480
		14	9,650

DISTRICT No. 3—CHESAPEAKE BAY (*Continued*)

Shipbuilding and Yard Location	Shipways	Ships Under Contract	D.W. Tons
*Newport News Shipbuilding & D. D. Co., Newport News, Va.	‡11	9	9,770
*Pusey & Jones, Wilmington, Del.	4	14	4,200

† Two for navy. ‡ Five for navy.

DISTRICT No. 4—FLORIDA AND GEORGIA

WOODEN VESSELS

*Hillyer-Sperry-Dunn Co. (operated by U. S. Shipping Board, Emergency Fleet Corp'n), Jacksonville, Fla.	†7	4	3,500
American Shipbuilding Co., Brunswick, Ga.	6	4	3,500
Tampa Dock Co., Tampa, Fla.	4	4	3,500
		4	3,500
J. M. Murdock, Jacksonville, Fla.	2	2	3,500
U. S. Maritime Corp'n, Brunswick, Ga.	4	6	3,500
North Carolina Shipbuilding Co., Morehead City, N. C.	2	2	3,500
Morey & Thomas, St. Johns, Jacksonville, Fla.	4	4	3,500
National Shipbldg. & D. D. Co., Savannah, Ga.	2	2	3,500
*Southland Steamship Co., Savannah, Ga.		7	Tugs

STEEL VESSELS

		4	3,500
	4	4	6,000
Merrill-Stevens Shipbldg. Corp., Jacksonville, Fla.		6	9,000
		1	6,000
Terry Shipbuilding Corp'n, Savannah, Ga.	8	10	3,500
		10	7,500
Oscar Daniels Co. (Tampa S. B. & Eng. Co.), Tampa, Fla.	7	10	9,500
		2	3,500

† Two for private owners.

DISTRICT No. 5—GULF PORTS, EXCEPT TEXAS

WOODEN VESSELS

*Merrill-Stevens Shipbldg. Corp'n, Slidell, La.	4	18	3,500
Dierks-Blodgett Shipbldg. Co., Pascagoula, Miss.	4	6	3,500
The Mobile Shipbuilding Co., Mobile, Miss.	6	18	3,500
Murnan Shipbuilding Corp'n, Pinto Point, Ala.	2	4	3,500
Hodge Ship Co., Inc., Moss Point, Miss.	4	4	3,500
Dantzler Shipbldg. & D.D. Co., Moss Point, Miss.	4	6	3,500
Jahncke Shipbuilding Co., Inc., Madisonville, La.	4	6	3,500

STEEL VESSELS

Jahncke Shipbldg. & D.D. Co., Madisonville, La.	3	12	5,000
Alabama D.D. & Shipbldg. Co., Pinto Island, Ala.	1	2	7,500
Alabama D. D. & Shipbldg. Co., Mobile, Ala.	2	2	3,500
Pensacola Shipbuilding Co., Pensacola, Fla.	5	10	9,000
Johnson Iron Works, Ltd., New Orleans, La.		6	Tugs

DISTRICT No. 6—TEXAS

WOODEN VESSELS

Universal Shipbuilding Co., Houston Ship Canal, Tex.	8	12	3,500
McBride & Law, Naches River, Beaumont, Tex.	2	4	3,500
Union Bridge & Const. Co., Morgan City, La.	6	6	3,500
National Shipbuilding Co., Orange, Tex.	†8	12	4,700
Lone Star Shipbuilding Co., Beaumont, Tex.	4	8	3,500
J. N. McCammon, Beaumont, Tex.	2	2	3,500
Southern D. D. & Shipbldg. Co., Orange, Tex.	5	5	3,500
Midland Bridge Co., Ship Channel, Houston, Tex.	6	6	3,500
Beaumont Shipbldg. & D.D. Co., Beaumont, Tex.	‡8	4	3,500
Heldenfels Bros., Rockport, Tex.	4	4	3,500

† One for private owner. ‡ Four for private owners.

DISTRICT No. 7—CALIFORNIA

WOODEN VESSELS

*Hammond Lumber Co., Humboldt Bay, Cal.	4	4	3,500
Kruse & Banks Shipbldg. Co., North Bend, Ore.	5	6	3,500
Fulton Shipbuilding Co., Wilmington, Cal.	4	6	3,500
Coos Bay Shipbuilding Co., Marshfield, Ore.	4	6	3,500
Ralph P. Chandler, Wilmington, Cal.	4	4	3,500
Benicia Shipbuilding Corp'n, Benicia, Cal.	†3	2	3,500
Rolph Shipbuilding Corp'n, Humboldt Bay, Cal.	†7	2	3,500

STEEL VESSELS

*Los Angeles Shipbuilding & Dry Dock Co., Los Angeles Harbor, Cal.	6	18	8,800
	7	20	9,400
Moore Shipbuilding Co., Oakland, Cal.		6	10,000
		7	9,070
Western Pipe & S. Co. of Cal., So. San Francisco, Cal.	4	18	8,800
Southwestern Shipbuilding Co., San Pedro, Cal.	4	10	8,800
Long Beach Shipbuilding Co. (Craig Shipbuilding Co.), Long Beach, Cal.	4	3	6,000
		2	3,000
Pacific Coast Shipbuilding Co., Suison Bay, San Franicsco, Cal.	4	10	9,400

DISTRICT No. 7—CALIFORNIA (*Continued*)

Shipbuilding and Yard Location	Ship-ways	Ships Under Contract	D.W. Tons
*Hanlon D. D. & Shipbldg. Co., Oakland, Cal...	3	6	5,350
		2	5,500
*Bethlehem Shipbuilding Corp'n, Ltd. (Union Iron Works), Alameda, Cal.....	7	12	10,100
		4	11,500
		2	11,800
*Bethlehem Shipbuilding Corp'n, Ltd. (Union Iron Works), San Francisco, Cal.....	§12		
Union Construction Co. (Union Indust. Works), Oakland, Cal.....	4	10	9,400

† One for private parties. ‡ Five for private parties. § Eight naval vessels.

DISTRICT No. 8—WASHINGTON

Wooden Vessels

*Sloan Shipyard Corp'n, Anacortes, Wash.....	6	16	3,500
Sloan Shipyard Corp'n, Olympia, Wash.....	†10		
*Grays Harbor M. S. Corp'n, Grays Harbor, Wash.	8	12	4,000
Sanderson & Porter, Wallapa Harbor, Wash....	5	10	3,500
*Grant-Smith-Porter S. Co., Aberdeen, Wash...	4	16	3,500
		2	3,500
Meacham & Babcock Shipbuilding Co., Seattle, Wash.	6	4	3,500
Nilsen & Kelez Shipbldg. Corp'n, Seattle, Wash.	3	4	3,500
*Seaborn Shipyards Co., Tacoma, Wash.....	4	8	3,500
Sabare Brothers, Tacoma, Wash.....	2	3	3,500
Wright Shipyards, Tacoma, Wash.....	3	4	3,500
Tacoma Shipbuilding Co., Tacoma, Wash.....	4	4	3,500
*Puget Sound Brdg. & Drdg. Co., Seattle, Wash.	6	8	4,000
*Pacific American Fisheries, Bellingham, Wash.	5	5	3,500
Allen Shipbuilding Co., Seattle, Wash.....	2	1	3,650

Steel Vessels

*Skinner & Eddy Corp'n, Seattle, Wash.....	5	20	8,800
		8	8,825
	5	8	8,825
Seattle Construction & Dry Dock Co., Tacoma, Wash. (Todd Shipyard).....	5	10	7,500
*Seattle Const. & D. D. Co., Seattle, Wash.....	6	12	7,750
Erickson Eng. Co., Inc., Seattle, Wash.....	5	10	9,400
Ames Shipbldg. & D. D. Co., Seattle, Wash...	4	13	8,760
*J. F. Duthie & Co., Seattle, Wash.....	4	22	8,800
G. M. Standifer Const. Corp., Vancouver, Wash.	5	10	9,500
Northwest Steel Co. (Williamette Iron Works), Portland, Ore.....	4	16	8,800
		15	8,800
*Columbia River Shipbldg. Corp., Portland, Ore.	2	8	8,800
		10	8,800
Albina Eng. & Mach. Wks., Inc., Portland, Ore.	6	4	3,800

† Two for private parties.

DISTRICT No. 9—GREAT LAKES

Wooden Vessels

*Lake & Ocean Nav. Co., Sturgeon Bay, Wis...	1	1	2,500

Steel Vessels

Saginaw Shipbuilding Co., Saginaw, Mich.....	4	12	3,500
	3	5	3,550
		3	4,200
		3	4,200
		4	3,550
The American Shipbldg Co. *Chicago, Ill.....	6	5	3,550
		3	3,140
		20	4,200
		11	3,550
The American Shipbldg Co. *Wyandotte, Mich	10	4	3,550
		12	3,270
		6	4,200
		8	3,550
The American Shipbldg Co. *Cleveland, Ohio	3	2	3,550
		4	3,100
		6	3,550
The American Shipbldg Co. *Superior, Wis..	6	6	4,200
		4	3,100
		11	3,550
The American Shipbldg Co. *Lorain, Ohio..	10	18	4,200
		13	5,680
*Toledo Shipbuilding Co., Toledo, Ohio.....	4	8	3,550
	4	10	2,930
*Globe Shipbuilding Co., Superior Wis.....	4	6	3,500
		4	3,500
*Great Lakes Eng. Works, Ashtabula, Ohio....	3	30	4,200
*Great Lakes Eng. Works, Ecorse, Mich.....	8	31	3,850
*McDougall Duluth Co., Duluth, Minn.....	4	10	3,500
		9	3,140
*Manitowoc Shipbuilding Co., Manitowoc, Wis.	6	9	3,400
		14	3,460
*Northwest Eng. Works (Hartman Grelling Co.), Green Bay, Wis.....		2	Tugs
Whitney Brothers, Superior, Wis.....		4	Tugs

DISTRICT No. 10—DELAWARE RIVER

Steel Vessels

Sun Shipbuilding Co., Chester, Pa.....	†5	4	10,000
		16	10,070
New York Shipbuilding Corp'n, Camden, N. J.	‡24	3	10,000
		¶21	8,620
Chester Shipbuilding Co., Chester, Pa.....	†7	28	8,860
Wm. Cramp & Sons S. & E. B. Co., Philadelphia, Pa.....	§9	9	6,860
New Jersey Shipbuilding Co., Gloucester, N. J.	7	12	5,000
*Pennsylvania Shipbldg. Co., Gloucester, N. J..	6	19	10,200

† One for navy. ‡ Three for navy. § Six for navy. ¶ Ten destroyers.

DISTRICT No. 11—OREGON

Wooden Vessels

Shipbuilding and Yard Location	Ship-ways	Ships Under Contract	D.W. Tons
G. M. Standifer Const. Corp., Vancouver, Wash.	6	6	4,500
G. M. Standifer Const. Corp., Portland, Ore...	4	10	3,500
Peninsula Shipbuilding Co., Portland, Ore.....	4	4	4,000
		4	3,500
Coast Shipbuilding Co., Portland, Ore.....	4	4	3,500
		4	3,500
Supple & Ballin, Portland, Ore.....	4	8	4,000
Sommarston Shipbldg. Co., Columbia City, Ore.	4	4	3,500
Wilson Shipbuilding Co., Astoria, Ore.....	4	6	3,500
Geo. F. Rodgers & Co., Astoria, Ore.....	4	4	3,500
St. Helens Shipbuilding Co., St. Helens, Ore...	4	2	3,500
Feeney & Bremer Co., Tillamook, Ore.....	4	1	3,500
McEachern Ship Co., Astoria, Ore.....	6	10	3,500
Grant Smith Porters S. Co., St. Johns, Ore.....	8	12	3,500

INDEPENDENT OF DISTRICTS

Fabricated Steel Shipbuilding Plants

American International Shipbuilding Corp'n, Hog Island, near Philadelphia, Pa.....	50	110	7,500
		70	9,000
Merchants Shipbuilding Corp'n, Bristol, Pa.....	12	60	9,000
Carolina Shipbldg. Corp'n, Wilmington, N. C...	4	12	9,600

Concrete Shipbuilding Plants

Fougner Amer. S. Co. S. B. Corp'n, North Beach, L. I.....	1	1	3,500
Liberty Shipbuilding Co., Wilmington, N. C...	4	8	3,500–7,500
Liberty Shipbuilding Co., Brunswick, Ga.....	1	1	3,000
San Francisco Shipbldg. Co., San Francisco Bay.		8	7,500
Total	834	1,977	13,718,850

Year's Output of American Shipyards Amounts to 1,430,793 Gross Tons

MERCHANT vessels built in the United States during the fiscal year ended June 30, as officially returned to the Commerce Department, Bureau of Navigation, numbered 1,622, of 1,430,793 gross tons. The output of the past four months, 706,084 gross tons, almost equaled that of the preceding eight months, and is greater than any previous annual output in our history.

The year's output is more than double the largest output of German shipyards in peace times. The output of the United Kingdom for the 12 months ended June 30 has not been stated, but for the 12 months ended May 31 it was 1,406,838 gross tons, or about 70 percent of the annual output of peace times.

Of the year's American output, 253 of 1,034,604 gross tons were sea-going steel steamers, 157 of 213,088 gross tons sea-going wooden vessels, and the remainder were vessels for the lakes, rivers, and domestic transportation. One concrete sea-going steamer of 3,427 gross tons is included.

The year's output is almost exclusively from established private shipyards, as the great shipbuilding plants like Hog Island, established through Government co-operation, had not begun to add finished ships to the cargo fleets to win the war.

Built for Foreign Owners

The vessels covered by the year's official returns to the Commerce Department, Bureau of Navigation, are almost wholly ships building or contracted for by private shipowners, American, British, French, or Norwegian, and in the main requisitioned by the Shipping Board, as relatively small tonnage originally contracted for by the Government was finished, but will appear in large volume in the new fiscal year's returns.

Of the year's output 48,364 gross tons were built for and delivered direct to foreign owners.

Output in Previous Years

As shown in Table II, the output for six-month periods, beginning with July, 1916, was as follows: July-December, 1916, 320,676 gross tons; January-June, 1917, 491,983 gross tons; July-December, 1917, 542,313 gross tons; January-June, 1918, 888,480 gross tons. The output for the current year will therefore far exceed that for the previous twelve months.

TABLE I.—NUMBER AND TONNAGE

GROSS TONNAGE OF MERCHANT VESSELS BUILT IN THE UNITED STATES (INCLUDING THOSE FOR FOREIGN OWNERS) AND OFFICIALLY NUMBERED DURING SUCCESSIVE 12-MONTH PERIODS, BEGINNING WITH THE 12 MONTHS WHICH ENDED JUNE 30, 1916.

	Seagoing.						Grand Total, including Non-Seagoing.	
	Steel.		Wood.		Total.			
	Number.	Gross.	Number.	Gross.	Number.	Gross.	Number.	Gross.
1916.								
June	....	....	....	....	....	....	1,030	347,147
July	....	....	....	....	....	....	1,012	361,313
August	....	....	....	.....	....	.....	1,042	398,671
September	....	.....	....	....	....	....	1,057	424,058
October	....	.....	....	.....	....	.....	1,086	476,922
November	....	.....	....	.....	....	.....	1,124	537,683
December	....	.....	....	.....	....	.....	1,179	555,262
1917.								
January	....	.....	....	.....	....	.....	1,230	602,449
February	....	.....	....	.....	....	.....	1,258	606,891
March	....	.....	....	.....	....	.....	1,314	630,508
April	....	.....	....	.....	....	.....	1,367	683,725
May	....	.....	....	.....	....	.....	1,445	713,071
June	114	468,502	80	131,449	194	599,951	1,546	812,659
July	124	513,567	84	143,778	208	657,345	1,630	871,080
August	128	537,804	93	152,765	221	690,569	1,681	904,354
September	132	547,325	100	162,646	232	709,971	1,688	942,516
October	130	553,975	115	184,287	245	738,262	1,683	962,969
November	139	538,206	123	192,515	252	730,721	1,701	949,601
December	142	605,738	137	211,830	279	817,568	1,699	1,034,296
1918.								
January	144	607,404	137	211,626	281	819,030	1,657	1,025,496
February	157	682,867	146	222,723	303	905,590	1,669	1,106,093
March	180	759,354	153	238,051	333	997,405	1,670	1,194,127
April	203	845,338	157	236,498	360	1,081,836	1,668	1,278,132
May	232	966,850	151	219,947	383	1,186,797	1,661	1,381,369
June	253	1,034,604	157	213,088	410	1,247,692	1,622	1,430,793

TABLE II.—OUTPUT BY MONTHS

VESSELS BUILT AND OFFICIALLY NUMBERED IN THE UNITED STATES FROM JULY, 1916, INCLUDING VESSELS BUILT FOR FOREIGN OWNERS.

MONTHS.	Seagoing.									
	Steel.		Wood.		Total.		Non-Seagoing.		Grand Total.	
	Number.	Gross.	Number.	Gross.	Number.	Gross.	Number.	Gross.	Number.	Gross.
1916.										
July	4	9,826	3	1,784	7	11,610	114	19,121	121	30,731
August	5	22,479	5	3,168	10	25,647	114	27,121	124	52,768
September	5	25,552	5	2,632	10	28,184	84	10,239	94	38,423
October	15	37,770	7	14,238	22	52,008	95	18,224	117	70,232
November	20	66,429	3	2,644	23	69,073	86	21,563	109	90,636
December	4	18,385	2	1,296	6	19,681	81	18,205	87	37,886
Total	53	180,441	25	25,762	78	206,203	574	114,473	652	320,676
1917.										
January	10	52,082	6	6,672	16	58,754	83	14,841	99	73,595
February	4	18,779	5	6,777	9	25,556	63	11,448	72	37,004
March	6	38,553	5	5,448	11	44,001	126	15,110	137	59,111
April	8	44 653	11	22,570	19	67,223	148	11,822	167	79,045
May	11	36,086	19	33,004	30	69,090	162	22,137	192	91,227
June	22	97,908	9	31,216	31	129,124	196	22,877	227	152,001
Total	61	288,061	55	105,687	116	393,748	778	98,235	894	491,983
July	14	54,891	7	14,113	21	69,004	184	20,148	205	89,152
August	9	46,716	14	12,155	23	58,871	152	27,171	175	86,042
September	9	35,073	12	12,513	21	47,586	80	28,999	101	76,585
October	13	44,420	22	35,879	35	80,299	87	10,386	122	90,685
November	19	50,660	11	10,872	30	61,532	87	15,736	117	77,268
December	17	85,917	16	20,611	33	106,528	52	16,053	85	122,581
Total	81	317,677	82	106,143	163	423,820	642	118,493	805	542,313
Total 1917	142	605,738	137	211,830	279	817,568	1,420	216,728	1,699	1,034,296
1918.										
January	12	53,748	6	6,468	18	60,216	39	4,579	57	64,795
February	17	94,242	14	17,874	31	112,116	53	5,485	84	117,601
March	29	115,040	12	20,776	41	135,816	97	11,329	138	147,145
April	31	130,637	15	21,017	46	151,654	119	11,396	165	163,050
May	*40	157,598	13	16,453	53	174,051	132	20,413	185	194,464
June	43	165,662	15	24,357	58	190,019	130	11,406	188	201,425
Total	172	716,927	75	106,939	247	823,872	570	64,608	817	888,480

* Includes 1 cement vessel of 3,427 gross tons.

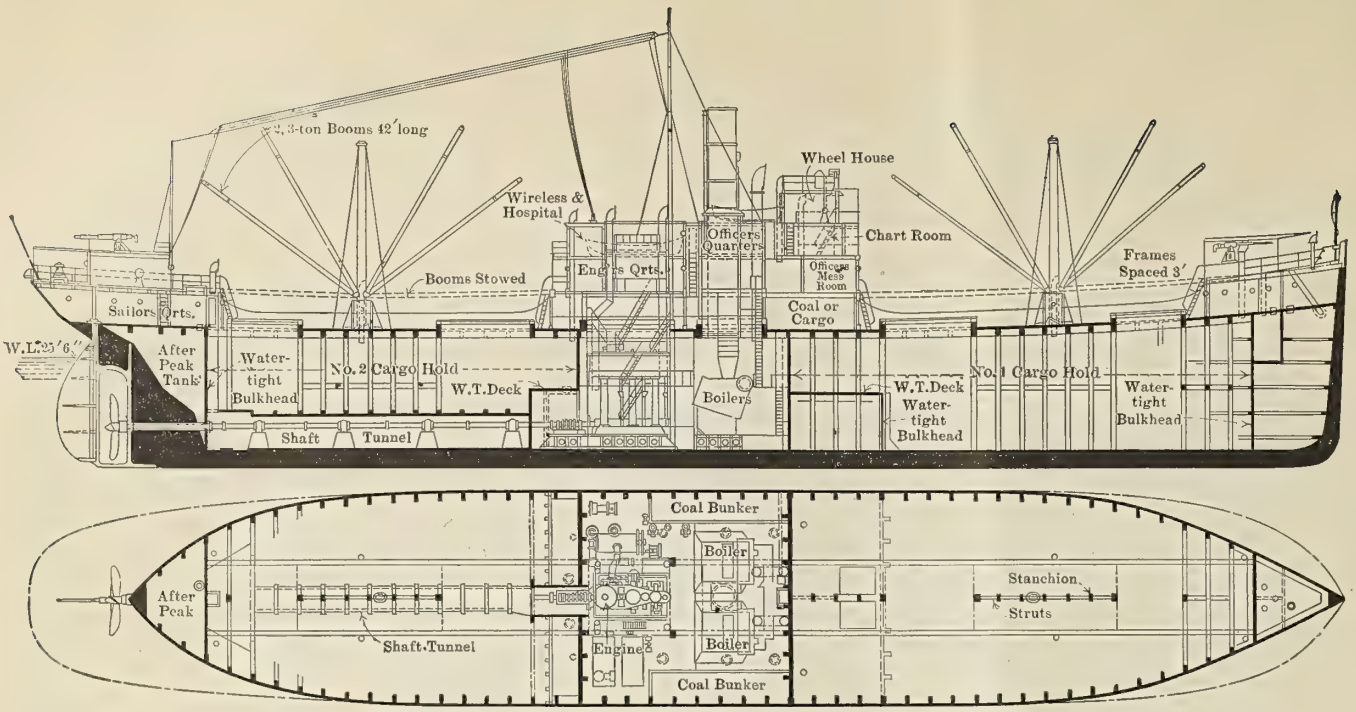


Fig. 1.—Inboard Profile and Hold Plan of 3,500-Ton Concrete Ship

Concrete Ship of 3,500 Tons Deadweight Designed by Emergency Fleet Corporation

IN a special report to the Chairman of the Shipping Board, R. J. Wigg, chief engineer, Department of Concrete Ship Construction, Emergency Fleet Corporation, sums up the conclusions of the Concrete Ship Department as to the advisability of constructing concrete ships as follows:

(1) The reinforced concrete ship can be built structurally equal to any steel ship.

(2) The available information assures, with all the certainty possible short of actual experience under service conditions, that the concrete ship will be durable for several years, assuring satisfactory service throughout the probable duration of the present war.

(3) The cost of the reinforced concrete ship complete will vary between $100 (20/16/8) and $125 (26/0/10) per ton deadweight, depending upon the number of ships built

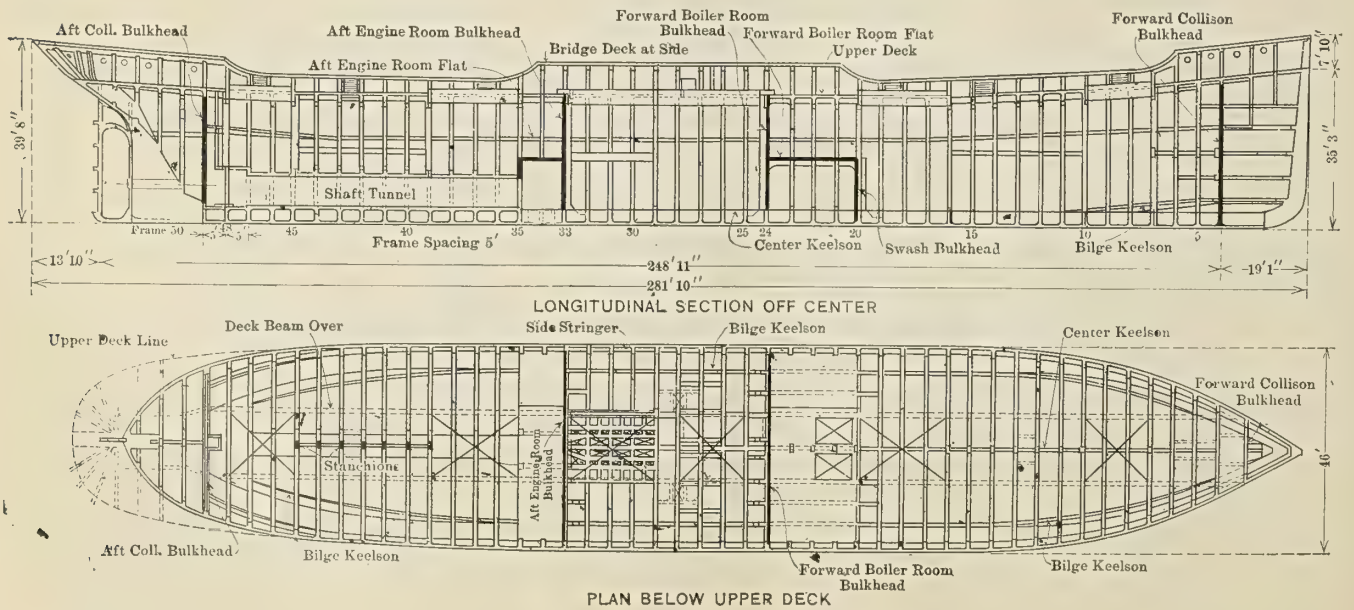
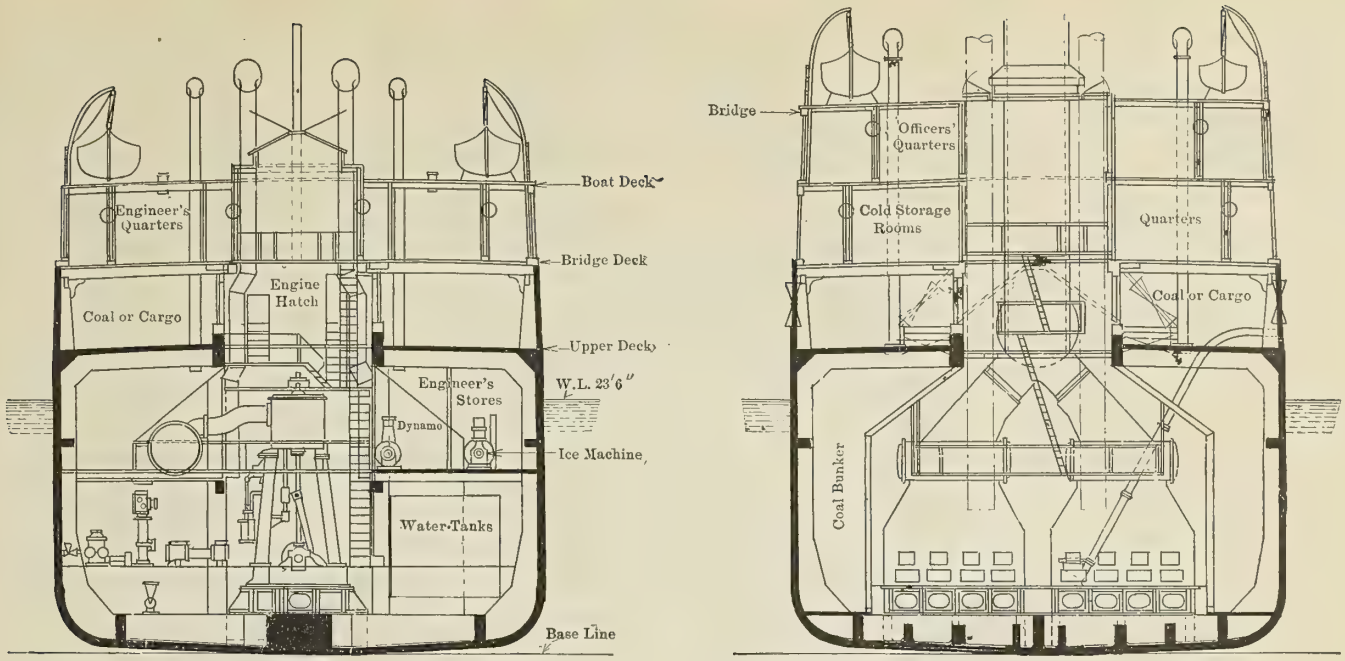


Fig. 2.—Frame Plan



Section Through Engine Room (Looking Forward) Section Through Boiler Room (Looking Aft)

Fig. 3.—Sections Through Machinery Space

and the conditions of construction. The cost of the hull only will be between $30 (6/5/0) and $40 (8/6/8) per ton deadweight.

(4) The construction of concrete hulls will not interfere with the present programme for the construction of steel and wood hulls in so far as labor or materials are concerned.

(5) The Concrete Ship Department has completed the detailed plans for a 3,500-ton concrete ship, so that construction of such ships can start immediately.

(6) It is estimated that between one hundred and fifty and two hundred 3,500-ton concrete hulls can, if construction is started immediately, be completed by December 31, 1918, totaling approximately 600,000 tons.

(7) It is further estimated, if the construction of yards is begun immediately and the construction of hulls of

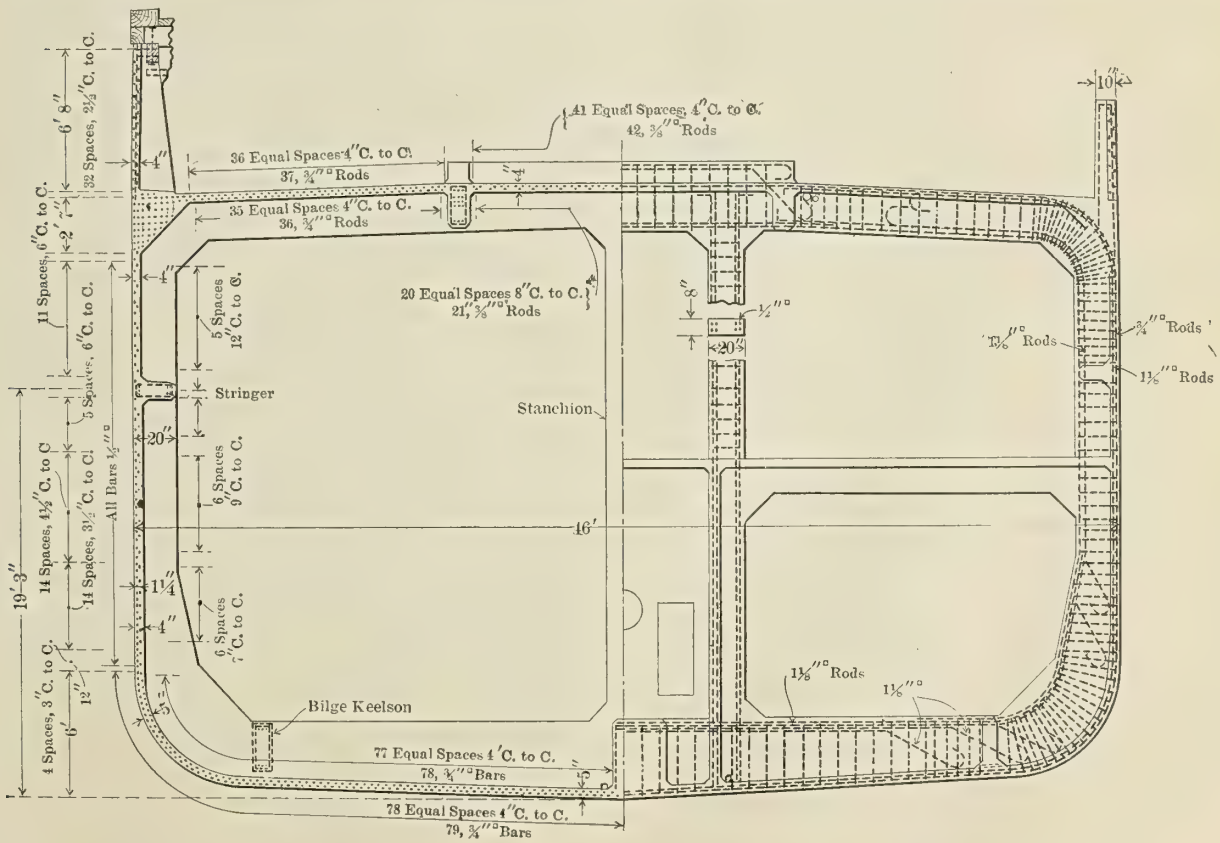

41 Equal Spaces, 4" C. to C.
42, ¾" □ Rods
36 Equal Spaces 4" C. to C.
37, ¾" □ Rods
35 Equal Spaces 4" C. to C.
36, ¾" □ Rods
20 Equal Spaces 8" C. to C.
21, ⅞" □ Rods
Stringer
Stanchion
Bilge Keelson
77 Equal Spaces 4" C. to C.
78, ¾" □ Bars
78 Equal Spaces 4" C. to C.
79, ¾" □ Bars
All Bars ½" □
⅝" □ Rods
¾" □ Rods
1⅛" □ Rods
1⅛" □

Fig. 4.—Midship Section, Showing Shell Reinforcement and Frame Details

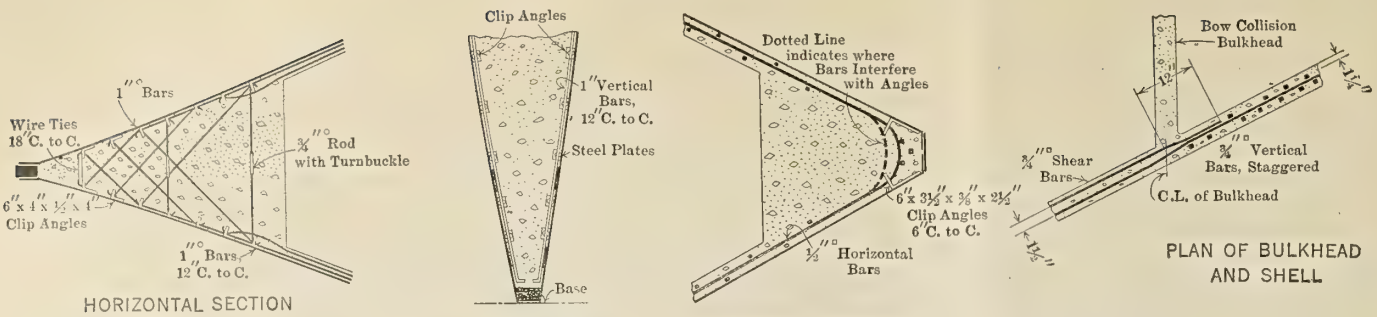

1" Bars
Wire Ties 18" C. to C.
¾" Rod with Turnbuckle
6" x 4" x ½" x 4" Clip Angles
1" Bars 12" C. to C.
HORIZONTAL SECTION AT STERN FRAME
Clip Angles
1" Vertical Bars, 12" C. to C.
Steel Plates
Base
VERTICAL SECTION AT STERN FRAME
Dotted Line indicates where Bars Interfere with Angles
6" x 3½" x ⅜" x 2½" Clip Angles 6" C. to C.
½" Horizontal Bars
HORIZONTAL SECTION AT BOW
Bow Collision Bulkhead
¾" Shear Bars
¾" Vertical Bars, Staggered
C.L. of Bulkhead
PLAN OF BULKHEAD AND SHELL

Fig. 5.—Construction Details at Stem and Stern

7,500 tons each commences by June, 1918, that two hundred and fifty can be completed by August, 1919.

The 3,500-Ton Concrete Ship

The standard concrete ship of 3,500 tons deadweight carrying capacity is of the same size, dimensions and form as the 3,500-ton standard wood ship (designed on page 294, MARINE ENGINEERING, July, 1917) except that the sheer line amidships has been slightly altered and no outer keel is fitted. The general arrangement follows closely that of the wood ship, including the number and location of bulkheads.

The propelling machinery design for the wood ship has been provided for without essential change in this vessel.

The principal dimensions of the concrete ship are as follows:

Length overall	281 feet 10 inches
Length between perpendiculars	268 feet
Beam, over shell	46 feet
Depth, amidships, on side	28 feet 3 inches
Draft	23 feet 6 inches
Full load displacement	6,175 tons

The comparative weights of similar ships built of concrete, wood and steel are given in Table I.

TABLE I.—COMPARATIVE WEIGHTS, CONCRETE, WOOD, AND STEEL VESSELS

	Concrete	Wood	Steel
Hull	2,500	2,300	1,160
Fittings, outfit, and equipment	191	191	180
Propelling machinery	206	206	200
Margin	75	80	60
Ship (light)	2,972	2,777	1,600
Reserve feed	80	80	80
Ordnance	23	23	23
Fuel	300	300	300
Stores	40	40	40
Cargo	2,760	2,180	3,057
Total deadweight	3,203	3,123	3,500
Full-load displacement	6,175	5,900	5,100
Percentage deadweight to full-load displacement	52	53	68.6

Metacentric Height, Stability and Period of Roll

The metacentric heights in the light (ship without cargo) and full load conditions are, respectively, 2.15 feet and 2.2 feet. The best practice at the present time places these values between the limits of 1 and 3 feet for vessels of this type and size.

The maximum righting arm occurs at 51.5 degrees and 46.5 degrees for the vessel light and fully loaded, respectively, the extreme ranges being 89 degrees and 81.5 degrees respectively.

The freeboard amidships at the side is 4 feet 9 inches.

While an investigation of the period of roll is a laborious operation of doubtful value and seldom attempted in the design of steel vessels, the Concrete Ship Department, nevertheless, considered it safe to say that the concentration of relatively great weight in the decks and shell in the case of the concrete vessel would aid materially in increasing the period of roll anticipated.

Strength of Hull

The strength of the ship as a girder supported on the crest of a wave amidships, hogging, and also on the crest of two waves, one at each end, sagging, was calculated for five conditions. The same basic conditions were assumed as to length, depth and form of waves and the same method of procedure that is standard practice in calculating the strength of steel ships was followed throughout. The maximum bending moments and fiber stresses in the steel reinforcements and concrete in the various conditions are given in Table 2.

TABLE II.—STRESSES IN GOVERNMENT 3,500-TON CONCRETE SHIP

Condition	Maximum Bending Moment Foot-Tons	Maximum Tons per Square Inch Fiber Stress in— Deck Reinforcement	Keel Reinforcement	Pounds per Square Inch Fiber Stress in Concrete
Ship without cargo, hogging	25,175	5.53	2.80[1]	728
Ship fully loaded, hogging	37,000	5.63	2.95[1]	766
Ship without cargo, sagging	14,400	1.28	2.63[2]	270
Ship light with enough cargo in forward hole to trim sagging	11,960	1.07	2.19[2]	210
Ship fully loaded, sagging	9,400	0.84	1.72[2]	70

[1] Keel [2] Deck

Good practice in steel merchant ships for a vessel of this type gives a maximum stress in the outer fiber of from 5 to 8 tons per square inch figured on the same basis as given above for the concrete ship. In addition to the stress due to the ship acting as a girder there is the local stress between frames, where the plating must act as a beam for that space. This action is seldom taken account of in steel ships but has been given full consideration in the design of the 268-foot concrete ship.

Local Strength of Hull Members

Although the transverse strength of vessels is not usually investigated with any degree of accuracy, except in the case of naval vessels, as the scantlings are taken from the books of the classification societies, nevertheless, in the case of the concrete vessel the complete transverse section was figured by the Concrete Ship Department with numerous cases of loading and heeling for every frame. The strength of the transverse frames was investigated for a large number of conditions of loading and for various immersions of the vessel.

The transverse frames are designed to stand the outside water pressure—water to the gunwales—with minimum cargo load, for maximum cargo load and a sagging draft of 15 feet 6 inches and for listed positions with loading light and heavy. All of these conditions of loading are to be met by the frames with stresses not to exceed 1,500 pounds per square inch in the steel.

The results of the analysis agree with those of Dr. Bruhn published in the Transactions of the Institute of Naval Architects, 1901 and 1904. From Dr. Bruhn's analysis it is clear that the design of the concrete frame is so made that the frame is working at the above-noted safe stresses under loadings that would develop double the steel stresses in a standard steel frame of similar dimen-

sions. In steel ships, this local action between frames would increase the stresses in the bottom plating of the ship acting as a girder from 5 to 10 tons, and in many cases to a much higher figure.

In this concrete ship design the tensile strength in the reinforcement, due to local bending, amounts to about 3 tons per square foot, bringing the total up to slightly less than 8 tons.

The bulkheads have been designed to carry a head of water on either side up to the deck. The collision bulkheads fore and aft were designed for 1,500 pounds per square inch in the concrete and 16,000 pounds per square inch in the steel. The steel stress in the engine

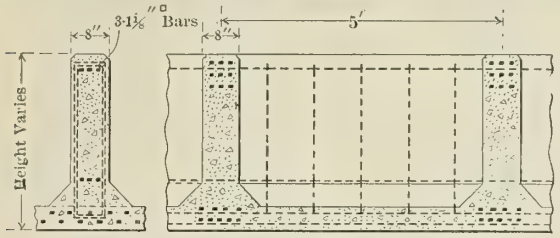


Fig. 6.—Sections Through Bilge Keelson

room bulkheads was advanced to 20,000 pounds per square inch.

In the design of bulkheads for steel ships it is common practice to allow a unit stress in the steel of 22,000 to 23,000 pounds per square inch.

The deck is designed to carry 5 feet of water or equivalent, which is in excess of loading on the decks of standard steel ships being built by the Emergency Fleet Corporation.

Hull Construction

As shown by the drawings, the parallel middle body of the hull extends 35 percent of the length. There is a dead rise of 9 inches. The hull is subdivided into five

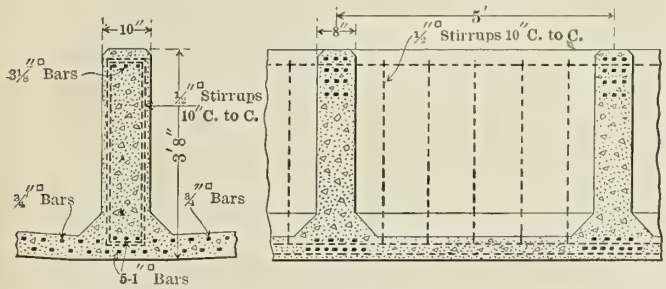


Fig. 7.—Sections Through Center Keelson

watertight compartments by four transverse watertight bulkheads and the bottom is strengthened by a center keelson and two bilge keelsons, while the sides of the vessel are strengthened by side stringers at about the middle depth of the hull.

The keelsons consist of concrete girders reinforced with rods in the upper and lower sections and are tied together with frequently spaced stirrups. The keelsons are worked into the transverse frames.

The frames, spaced 5 feet apart, are also reinforced concrete girders and are continued at the main deck to form the deck beams supporting the main deck, which is made of reinforced concrete slabs 4 inches thick.

The shell of the vessel is 5 inches thick on the bottom and up to 6 feet above the base line, while the remainder is 4 inches thick. The shell is reinforced at the outer and inner edges with ½-inch to ¾-inch square bars

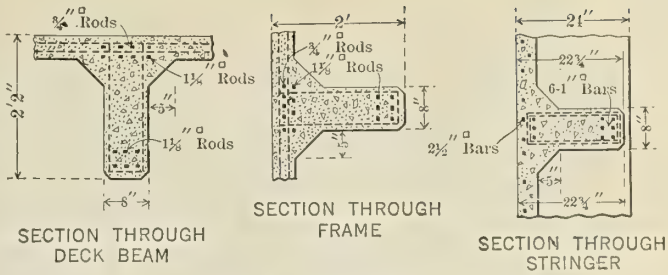


Fig. 8.—Structural Details

parallel to the waterline and spaced from 4 inches to 12 inches between centers. The horizontal reinforcing rods are located 1¼ inches from the face of the concrete shell. Vertical ¾-inch shear bars are also fitted between the horizontal rods extending clear around the shell and deck.

Between the hatches in the cargo holds the deck beams are supported by reinforced concrete stanchions. The foundations for the machinery consist of steel plate girders seated on extra heavy framing consisting of longitudinal reinforced girders.

As previously stated, the hull is subdivided by four transverse watertight bulkheads, two of which are the

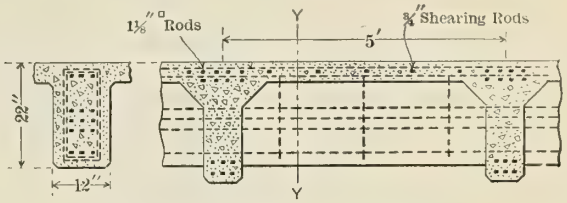


Fig. 9.—Sections Through Deck Beams

collision bulkheads and two inclosing the machinery space. The bulkheads consist of concrete slabs reinforced with transverse and longitudinal steel and stiffened by vertical stringers and beams which are tied into the main frames and deck beams.

Storage of Bituminous Coal

The more general storage of coal during the summer months is coming to be recognized as the only practical means of avoiding a coal shortage during the winter. Many corporations and individuals will this year undertake, for the first time, to store large quantities of coal. The storage of bituminous coal presents certain difficulties because of its tendency toward spontaneous combustion, with its attendant dangers and losses. The methods to be employed in avoiding spontaneous combustion have not generally been well understood, and those which have seemed successful in some cases have failed in others.

The Engineering Experiment Station of the University of Illinois has just completed a study of the problems involved in coal storage and has published the results in a 200-page illustrated book designed as Circular No. 6, "Storage of Bituminous Coal." The study was made under the direction of H. H. Stoek, professor of mining engineering. The reasons and advantages of storing coal are given, the kinds and sizes of coal which may be safely stored are described, and the many factors entering into successful storage are discussed.

Copies of Circular No. 6 may be had by addressing the Engineering Experiment Station, Urbana, Illinois. The price is forty cents per copy.

Fig. 1.—Outside Forms Erected for Pouring Concrete Barge at Peekskill Shipyard

Concrete Barges*

Brief Description of Design, Method of Construction, Materials Used, Method of Waterproofing and Launching of Concrete Barge

BY LOUIS L. BROWN†

THE first concrete boat built by the Louis L. Brown Company, New York, was a deck barge 112 feet long, 33 feet wide and 10 feet deep. It has 18 inches shear and 2 inches camber in the deck. The boat is divided into six compartments by one longitudinal and two transverse bulkheads. The bottom and deck beams are carried by longitudinal reinforced concrete trusses. The panel length of these trusses was 7 feet center to center,

Fig. 2.—Concrete Barge Ready for Launching

and the depth equal to the depth of the boat. They are spaced 5 feet 4 inches apart across the width of the boat and are reinforced to take care of any hogging or sagging strains due to the following conditions:

1—The central third of the boat loaded with the end thirds light.

2—The end thirds loaded and the center third light.

3—One-third the load on one end of the boat.

4—The ends of the boat supported on the crest of a wave equal in height to 1/20 its length.

5—The center of the boat supported on the crest of a wave equal in height to 1/20 its length.

6—The boat light supported in the extreme ends with no buoyancy.

The bottom, sides and deck slabs are 2¾ inches thick, supported by beams 3 feet 6 inches center to center. The cabin deck bulkheads and fenders are built of wood. The stress used in the design are:

Reinforcing steel—16,000 pounds per square inch.

Extreme fibre stress in concrete—800 pounds per square inch.

Allowable shearing stress in plain concrete—50 pounds per square inch.

Allowable shearing stress in beams reinforced with bent-up rods and stirrups—125 pounds per square inch.

Allowable bond stress—100 pounds per square inch.

The boat was built for side launching. The building ways were spaced 14 feet center to center. The forms were built in panels and bolted together. The bottom panels which were carried by the building ways were supported at the ends by wedges, which permitted them to be removed before removing the building ways.

As the cement gun was used in concreting the sides and bottom only one form was necessary. This was placed on the outside of the boat. The materials used were mixed dry in a batch mixer and conveyed to the guns, located so as to cover the entire boat.

All materials were tested and favorably reported for use for concrete in sea water by the Pittsburgh Testing Laboratory.

The proportions used in the mix varied. In the bottom it was one part by volume of cement, 1½ parts by volume of sand and two parts by volume of limestone screenings. In the sides the mix was one part by volume of cement to 1½ parts by volume of sand. In the interior beams, trusses and deck it was one part by volume of cement, 2 parts by volume of sand and two parts by volume of limestone screenings. The limestone screenings were screened through a ¼-inch screen and were well graded in size Giant Portland cement was used throughout in the construction of this boat.

The reinforcement used in all slabs and bulkheads was Clinton electric weld galvanized wire mesh No. 3 and 8 wire spaced 2 inches by 16 inches. All reinforcing rods used in the beams were Havemeyer bars. This reinforcement, together with the forms for the bottom beams and the ribs in the side, was supported from the top by beams spanning the width of the boat.

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* Paper read before American Concrete Institute, Atlantic City, N. J., June 29.

† Louis L. Brown Company, Inc., 30 Church Street, New York.

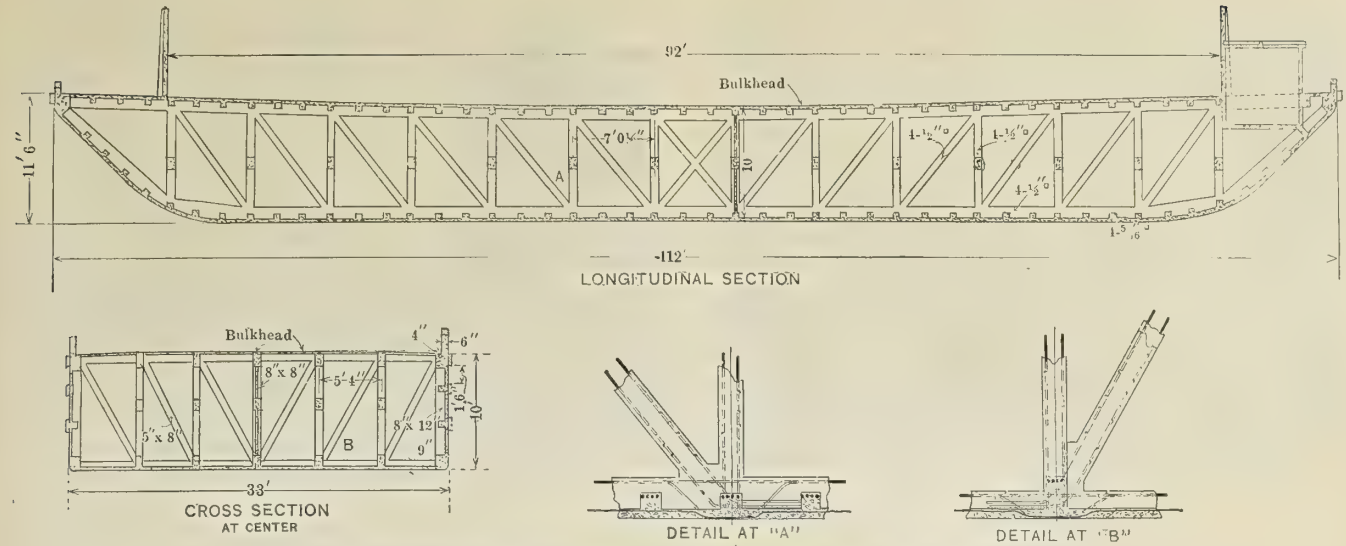


Fig. 3.—Longitudinal Section, Midship Section and Details of Strut Construction

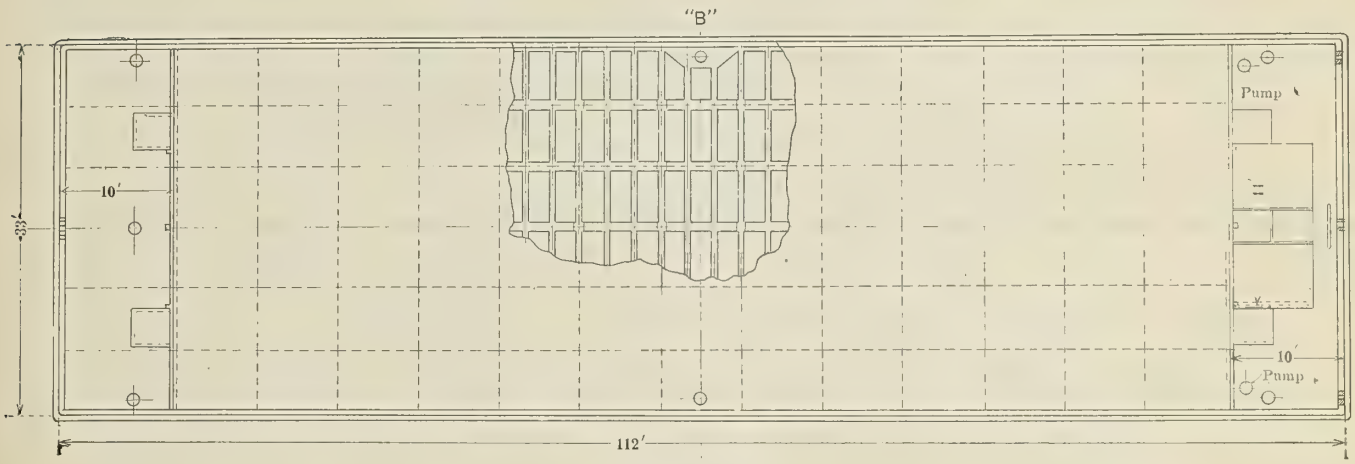


Fig. 4.—Deck Plan

The concrete was applied in the outer hull in three operations.

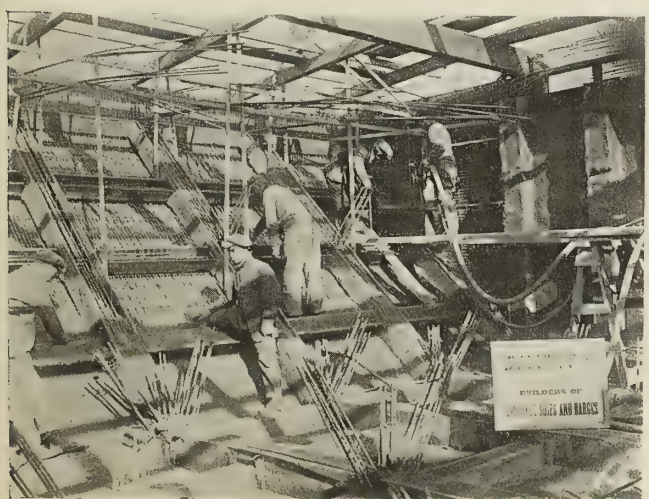
First, the bottom slab and beams were concreted.

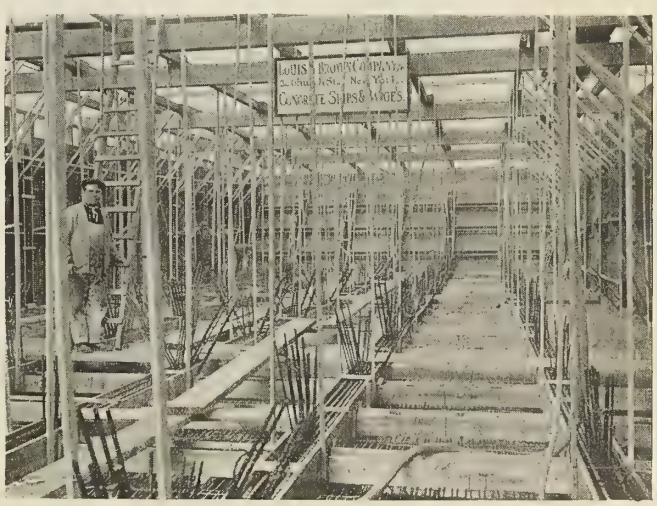
Second, the side slab and beams for approximately ½ the height of the sides and the

Third operation completing the sides.

It was necessary to concrete the sides in two operations as it was found in attempting to concrete a vertical slab of this thickness with the cement gun for a greater height than about 5 feet that there was a decided tendency for the concrete drag or pull down, causing it to crack before it had set. The remainder of the boat was poured in two operations.

The bitts were made of 10-inch pipe with holes through





Figs. 5 and 6.—Building Molds Around Struts and Diagonals at Ends and Amidships

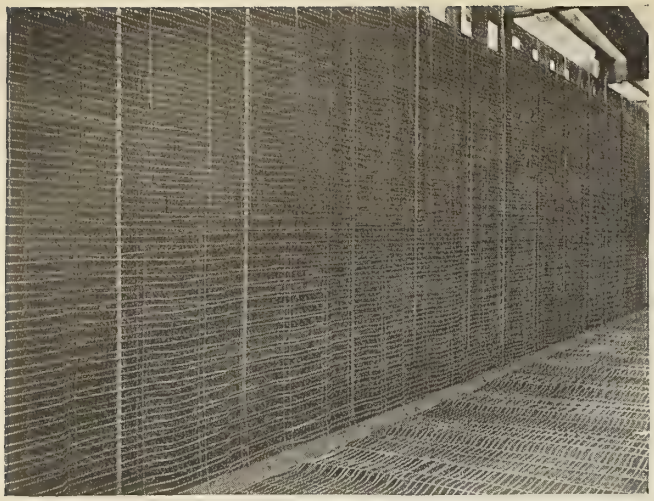


Fig. 7.—Reinforcing Rods on Side and Bottom of Barge

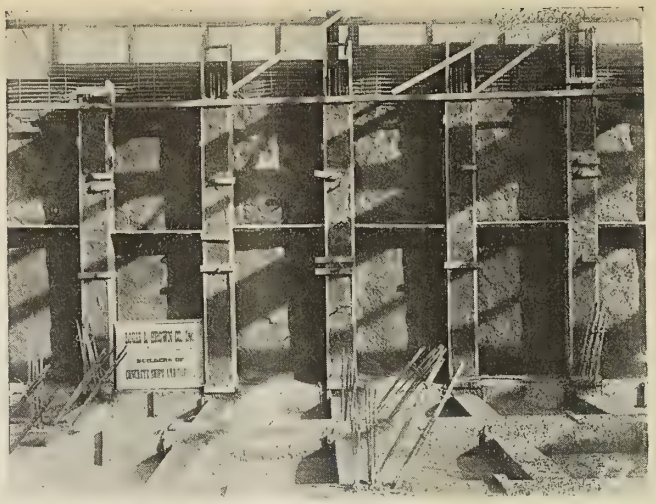


Fig. 8.—Removing the Molds After Pouring the Concrete

the bottom and sides for reinforcing rods, which spread out on the deck.

Three sets of 6-inch by 8-inch fenders were attached to the sides of the boat by bolting through the frames. Holes were provided in the concrete for the bolts by wooden pegs placed in the forms before concreting. After the forms were removed the pegs were bored out of the concrete. Marine glue made by the New-Pro Chemical Company was heated and poured into the bolt holes and the bolt for attaching the fenders was inserted while the glue was hot, the glue filling any space between the bolt and the concrete.

It was intended to launch this boat in the Fall of 1917, but upon removing the outside and bottom forms it was found that the product obtained by the use of the cement gun was not sufficiently uniform to insure a watertight hull. It was necessary to go over the boat very thoroughly and remove the sand pockets or defective concrete and replace with new concrete.

While the writer believes that it is possible to build a watertight hull with the cement gun with less sand pockets than was encountered in the construction of this boat, he does not believe, even under the most favorable conditions as to the design of the boat and in the operation of the gun, that sand pockets can be entirely eliminated. After all the defective concrete was replaced, the hull was painted with a neat cement grout, which was thoroughly rubbed into the pores of the concrete.

Four launch ways were used in launching, spaced so as to divide the load as equally as possible. The declivity of the ways was ¾ inch per foot, and the pressure was approximately 2½ tons per square foot of way. The launching was very successful, and the boat draws 3 feet 8 inches of water when light, and shows no leakage.

After having made a thorough study in the design and in the methods of construction of concrete barges, the writer believes that there are no difficulties that cannot be overcome, and that eventually reinforced concrete will prove to be the desirable material for the construction of barges and other floating craft, both from the point of view of first cost and for serviceability.

Concrete Shipyard at Wilmington, N. C.*

Description of Plant Erected by Liberty Shipbuilding Company, Boston, Mass., for Building Concrete Ships

A. G. MONKS†

THERE is little experience yet in design of concrete ships and less in design of plants as compared with the well-established building of steel or wooden ships. Changes and improvements may confidently be expected. At this date the reproduction in concrete of the framing and the form of steel ships has been wisely adopted, and has been followed by the British engineers and is advised by the Joint Committee of the American Concrete Institute and the Portland Cement Association and conservative naval architects and engineers.

Controversy over the merits and demerits of design of ships, concrete for use in sea water, comparative costs of maintenance, initial costs of net cargo capacities with per ton costs of transportation, ultimate length of safe service and the final place the ships may occupy in the economics of ocean transportation are not good questions for forcing upon the now heavily overloaded public's mind. They are still open questions whose existence may well stimulate keenest rivalry for their solution by those who are chosen for that work, and as well those who are technically capable and have not yet been delegated to some phase of the question.

The Liberty Shipbuilding Company, of Boston, have one of the five agency contracts for concrete ships. These will be built at the yards at Wilmington, N. C. The fact

* From a paper presented at the Annual Meeting of the American Concrete Institute, Atlantic City, N. J., June 27-29.

† Monks & Johnson, Architects-Engineers, Boston, Mass.

that contract shipbuilding is still in the pioneer stage has determined the character of construction of the yard; which will be temporary, with light wooden construction.

Rapid changes in yard design and equipment and larger salvage of materials of yard and equipment will be possible, more rapid prosecution of the first shipbuilding itself can take place, and less initial cost will be incurred. An example of possible change of yard design is the use of steel forms (as the art of concrete shipbuilding advances). The design of the yard will also be governed by local conditions, the site, the market for building materials, the number and size of vessels to be built and the climate.

Discussion of this yard divides itself naturally into groups—the site, water basins and shipways; the concrete department, erecting machinery and the general storehouse; the traffic service of standard and narrow gage railways, paved truck roads and rolling stock; the timber department of storage open and enclosed and wood working buildings and machines; steel storage and steel working buildings; the general yard service of water, fire protection, sewerage and electricity and the provisions for the main office, the yard employees and the troops to be stationed at the yard.

Shipyard Site

The site is in the City of Wilmington, N. C., on the Cape Fear River, about 30 miles from the sea. A deep channel has recently been dredged by the site to a point above the city. The top soil is marsh mud, some fifteen to twenty feet deep, overlying sand and gravel base. The channel dredging furnished material for hydraulic sand fill over considerable portion of the thirty-five-acre site. Additional dredging between channel and site and from the launching basins will provide further fill. The site has a river frontage of 3,500 feet, about 1,400 feet of which is now being developed to a depth of eleven hundred (1,100) feet. Within this space provision is being made for four ways in the form of three launching basins with two piers having launching ways on both sides, parallel to the basins. The basins or docks are 460 feet long and 160 feet wide and are dredged to a depth of 20 feet at low water. The piers are 350 feet wide. Wooden piles with heavy timber capping support the ships during construction and launching. A heavy bulkhead at the pier edge retains the sand fill which forms the working deck. The pier slopes from high water level at opposite edges, at the rate of one and one-eighth inches per foot until it reaches the level of the central portion five feet above high water. The tankers are to be 420 feet long, 53 feet wide. They will be launched sidewise.

Storage of concrete materials with capacity for one ship will be on the piers between the building slips so as to serve a ship either side. The cement will be stored in bags in a wooden shed, and the sand and stone will be piled in the open.

Two single cubic yard concrete mixers, mounted on wheels, will be moved from ship to ship. When in operation, they will be placed between the materials and the ship. A spare mixer will be provided.

Shipyard Derricks

Two shipyard derricks located at the shipways will handle the forms, reinforcing steel, steel and iron castings, and concrete. These derricks will be of three-ton capacity, at 75 feet radius, with towers 50 feet high. Both will be in operation on one ship during the pouring of the concrete. At other times they will be used among the ships under construction as required. These derricks travel on rails 24 feet apart and have a wheel base of 24 feet. They can be moved from ship to ship by means of a transfer car running along the head of the docks. This car will be made strong enough to enable the derricks to be used while on the transfer car in unloading materials from lighters in the docks.

A general storehouse will be provided at the head of the basin between two piers, thus serving four ships. This will be an enclosed wooden building to house general supplies, rigging, tools, and spare parts for the yard machinery.

Transportation Facilities

The main line of the railroad enters the yard at the rear of one end and runs parallel with the river throughout the extent of the present development and can be extended if the yard is enlarged. From the main line spur tracks are run to the lumber storage and to the piers. One spur track runs through the steel storage and bending space, another runs in front of the general storehouse and along the form storage; other spurs serve the mold loft and carpenter shop. Thus every process in the yard is thoroughly served with standard gage railroad, except that the railroad used to take lumber from the storage piles to the saw mill and the carpenter ship is narrow gage. Paved roads parallel the railroad everywhere, and thus when cars or railroad may not be available automobile trucks will be used instead.

The yard will be provided with a small number of standard gage railroad cars and a locomotive. A larger number of narrow gage cars will be provided for handling lumber. The number of automobile trucks which will be required to supplement railroad transportation has not yet been determined.

Rough lumber storage is beside the yard's service railroad, and is in the open except as experience may call for roof over portions; adjoining is the sawmill for cutting to required sizes and for dressings; then lumber is taken to finished lumber storage with finished lumber purchased directly.

Shops

The mold loft is one story, 90 feet by 260 feet; the central bay 60 by 260 feet clear of posts; flooring of white pine carefully leveled constitutes a full-size drawing board on which the ship's lines are laid out and from these the molds or templates are made.

The carpenter shop is one story, wooden, sixty by two hundred feet, with an ell sixty by eighty feet near one end in which woodworking machinery is located. At the other end of the shop is a high portion in which bow and stern forms are built to full height. The machinery ell has enclosing side walls. This shop is located near the mold loft from which come the molds according to which the forms are built.

The oil process building will house oil dipping tanks and drain racks. The lumber for the facing of the molds will be the best seasoned stock obtainable. It will be shipped to us in closed cars, then dipped in linseed oil, then as assembled all joints are to be painted. The finished sections of flat forms will be dipped and the surface that has contact with the concrete will receive a final coat of paint.

Form storage buildings are to be merely shelter roofs and will be located close by the building ways. They will have enough space for the storage of forms for four ships. The flat pieces and panels will be piled up but the large built-up forms for the curved surfaces cannot be piled.

Reinforcing steel will be taken off the cars and placed in storage racks and will be sorted to size. Space will be provided for four thousand tons. About twelve hundred tons are required for each ship.

Cutting shears and bending tables will be under a

shelter roof: cut and bent steel will be taken on standard gage cars and stored in the open alongside the railroad tracks (at convenient places).

Water Supply, Fire Protection, Sewerage and Power

Water services, for manufacturing, drinking and sanitary purposes will be provided from the city supply. The city will bring this to the yard in a six-inch main and the shipbuilding company will provide its own distributing system.

Water for fire protection will be pumped from the river probably into an elevated tank to supply the automatic sprinklers and yard hydrants. It is expected that all buildings will be protected by automatic sprinklers, well placed hydrants and hose houses.

A city sewer now runs through the site and empties into the river. All sewerage and drainage of the yard will connect with this sewer or will empty directly into the river. Electricity both for power and for lighting will be purchased from the local public service company, who will completely install it.

An additional "breakdown" power station having capacity enough to light the yard (in case of a breakdown during the concreting of a ship) will be provided. The concrete is to be poured continuously from start to finish to avoid construction joints. It is expected that the pouring of one ship will take three or four days' continuous work. The lighting service covers the entire yard, the buildings and the protective fence about the yard.

Electric power will be used for the woodworking machines and for the steel bending machines. The mixers and derricks have their own steam power.

The gate house, employment office and first aid rooms, are of more or less standard arrangement. The gate house is designed to pass two thousand men. The restaurant is to be a two-story, wooden, fully supplied with screens, with kitchen on first floor and seats for two hundred and fifty men—provision has been made to double the capacity, if desired. The service will be caféteria. The second floor has a lunch room for the office force and a conference lunch room for department heads.

Military Protection

For the troops to be stationed at the yard, barracks with the requisite number of additional buildings, officers' quarters, cook-house, messhouses, etc., will be built. The presence of uniformed soldiers at the shipbuilding yard has been found to be important and beneficial, not only for the protection of the yard from marauders, but as a constant reminder to the men of the cause for which the shipbuilding work is being carried on.

The office building is two-story wooden, for the executive and clerical force of the Liberty Shipbuilding Company, its engineers and superintendent and the government engineer and auditor.

Side-Launching Ways

It was noted earlier that the ships are to be launched sidewise; one of the interesting features discussed between the Emergency Fleet Corporation and ourselves is the construction of the ways for side-on launching. It has been determined that this is preferable to end-on for several reasons, among them being that side-on can be used on narrow channels, and that a ship may be built on a level keel with greater ease in assembling forms, placing of steel, pouring of concrete and generally in the construction.

In end-on launching the stern of the ship entering the water first floats before the bow clears the ways. The ship is thus suspended by the bow and stern, and severe stresses are induced. The stresses of side-on launching are very much less severe. Again, a steel ship hull has attained its total strength at launching, but the concrete hull needs a longer period to reach its maximum strength. Side-launching has been used considerably on the Great Lakes and in other places, and is used on the Clyde for steel vessels due to the narrow channel.

The disadvantages of side-launching, which some regard as sufficient reason for preferring end-on, are that it is more difficult to reach the out-board side of the ship and to work there and enclosing structures to provide protection from the weather and supports for overhead traveling cranes is a great deal more expensive and the whole of one side has to be built removable, while in the case of end-on launching the doorway is much smaller.

Roofing over the ship during construction is necessary in the south on account of frequent showers, often followed by strong sunlight. This is particularly important during the process of concreting.

The mold loft is nearly completed, and we hope within ten days to be laying out the lines of the first 3,500-ton vessel.

Progress of Concrete Shipbuilding

A word on concrete shipbuilding elsewhere may fit properly in this paper:

Britain has six 1,150-ton deadweight capacity vessels building at Barrow-in-Furness, their design following the steel framing.

Spain is now building at Barcelona 40,000 tons in 300-, 500- and 1,000-ton sizes.

Norway continues to build lighters, sea tugs and small vessels by the Fougner-Ferro Concrete Shipbuilding Company, who have established also in New York and are building a 3,000-ton vessel under U. S. Government contract at Flushing, L. I.

The *Faith* is now nobly afloat and passing the tests well; The Liberty Shipbuilding Company is building a 3,000-ton vessel at Brunswick, Ga., under U. S. Government contract; the U. S. Shipping Board has let five agency contracts which will provide about 292,000 tons more capacity.

The total tonnage of concrete ships now being built or just contracted for is about 350,000 tons. This nearly equals the world's total loss for May. The loss by submarine and all other marine risks is given at 355,694. This comparison shows what a large factor the concrete ship has at once become.

The U. S. Shipping Board has decided on the complete try-out of concrete ships; has put the task up to the engineers and the builder; it is now ours to undertake it. It is now no longer a question of whether concrete ships can be made or whether they will ever replace steel and wooden ships; the vital question is to increase our total tonnage. We may depend on this being the basis of judgment of the Shipping Board when they adopted the programme.

The world's tonnage needed is in large figures. Mr. Hurley has publicly stated that America's share may be 25,000,000 tons by 1920. The net minimum tonnage to maintain an American soldier in Europe is given as five tons—apply this to 5,000,000 men, which our overseas army may reach, and the 25,000,000 tons which Mr. Hurley names is all absorbed to care for them.

The building of concrete ships is one of those engineering problems which have been forced to the forefront as war measures. I believe confidently that the engineers of the United States will solve this problem for the U. S. Shipping Board.

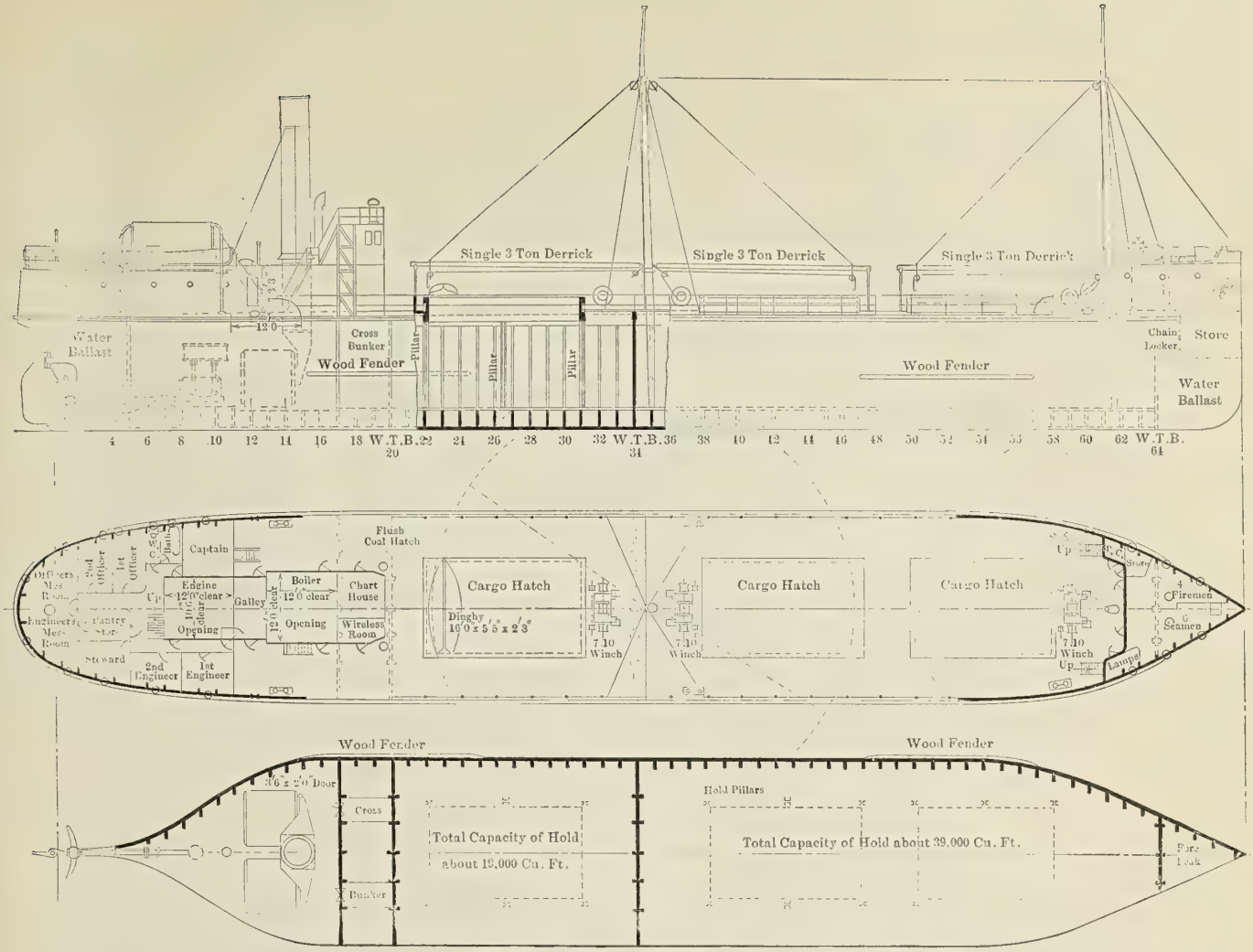


Fig. 1.—General Arrangement Ferro Concrete Cargo Boat; Length B. P., 205 Feet; Beam, 32 Feet; Molded Depth, 19 Feet 6 Inches

Design and Construction of Self-Propelled Reinforced Concrete Sea-Going Cargo Steamers now Building in Great Britain*

BY T. G. OWENS THURSTON

FOR years past one has heard of the construction of small vessels or barges of ferro-concrete, but these were never of sufficient size or importance to warrant closer investigation, and the whole subject appeared to be one that could safely be ignored so far as ocean-going ships were concerned.

The enormous losses of cargo-carrying ships during the war, coupled with the great scarcity of steel for shipbuilding on account of its diversion to other uses, have made shipbuilders endeavor to find some other material to replace steel for ship construction, even if only as a temporary measure; in this particular direction, shipowners have perhaps been really more progressive in their ideas than the shipbuilders. It was largely owing to shipowning friends of mine, who recognized the disastrous effect which the immense losses of mercantile tonnage would eventually have on the country, that steps were taken which led to the inception of the design and construction of the ships forming the subject of this paper. Without knowing anything as to the merits of ferro-concrete for shipbuilding purposes, they considered that if small craft had already been built with such material it was worth a trial, under present conditions, in larger ones, and after much consideration and investigation of the work previously done in this direction the author finally agreed with them.

The possibility of building wooden ships to make up for the scarcity of steel ships had been carefully considered, but it was found that although the timber supplies in certain countries were adequate for the purpose, a long time must elapse before green timber would be sufficiently seasoned to allow of its efficient use in ships'

* Paper read at the spring meetings of the fifty-ninth session of the Institution of Naval Architects, London, March 22, 1918.

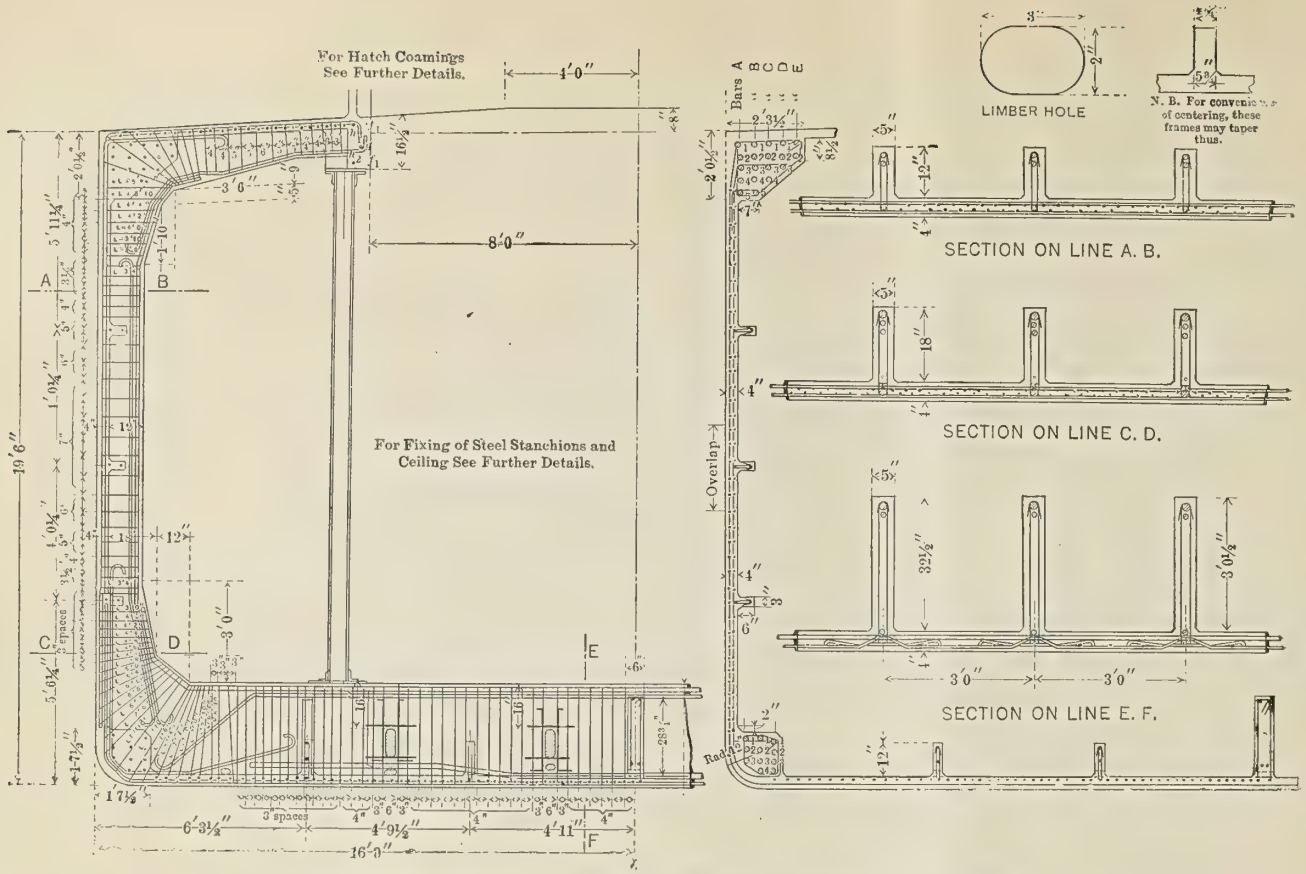

For Hatch Coamings See Further Details.
For Fixing of Steel Stanchions and Ceiling See Further Details.
LIMBER HOLE
SECTION ON LINE A. B.
SECTION ON LINE C. D.
SECTION ON LINE E. F.

Fig. 2.—Middle Body Frames, Sides and Bottom from Stations 3½ to 8½

hulls, although in many cases such timber has been used, and has proved more or less satisfactory for a limited time. In addition to this, the problem of skilled labor would have been accentuated rather than relieved, as it was a practical impossibility to get a sufficient number of men skilled in wooden shipbuilding to allow of construction except on a very moderate scale. These and other considerations led us to abandon the idea of wooden shipbuilding as an efficient substitute under the present urgent circumstances in favor of ferro-concrete, the latter being a material which, if successful, would at once allow a large addition to be made to the present output of cargo-carrying tonnage. Moreover, the system of construction calls for a minimum amount of steel and a minimum amount of skilled labor. Such construction also reduces capital expenditure on yard plant, as it is much less costly than ordinary shipyard plant and requires less skilled attention. Another point in favor of ferro-concrete construction is that, compared with ordinary shipyard labor, there is not so great a variety of trades involved. For example, the same men who, at a later date, are employed on casting the hull, are in the initial stages utilized in casting and laying concrete blocks and in making ferro-concrete piles for the building berths and other necessary preliminary work, for which this material can be used extensively instead of timber or steel, both of which require skilled labor of different trades.

Although the suitability of ferro-concrete under present abnormal conditions and on economical considerations was apparent, its acceptability for ship construction had to be investigated from the naval architect's point of view. With this object in view, we decided to design a sea-

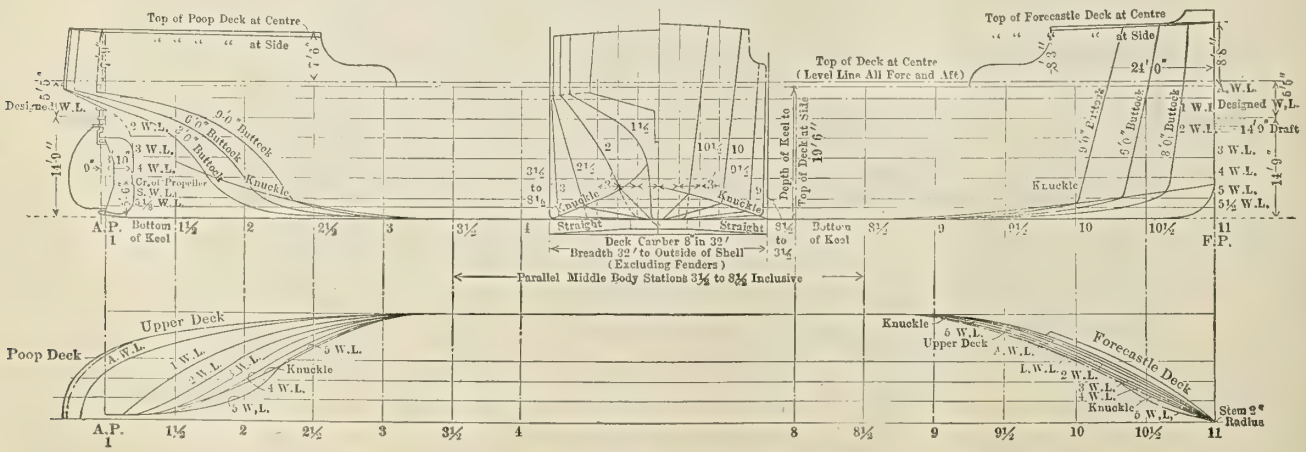

Top of Poop Deck at Centre
Top of Forecastle Deck at Centre
Top of Deck at Centre (Level Line All Fore and Aft)
Designed W.L.
Deck Camber 8 in 32'
Breadth 32' to Outside of Shell (Excluding Fenders)
Parallel Middle Body Stations 3½ to 8½ Inclusive
Upper Deck
Poop Deck
Forecastle Deck
A.P.
F.P.

Fig. 3.—Lines of Ferro Concrete Cargo Boat

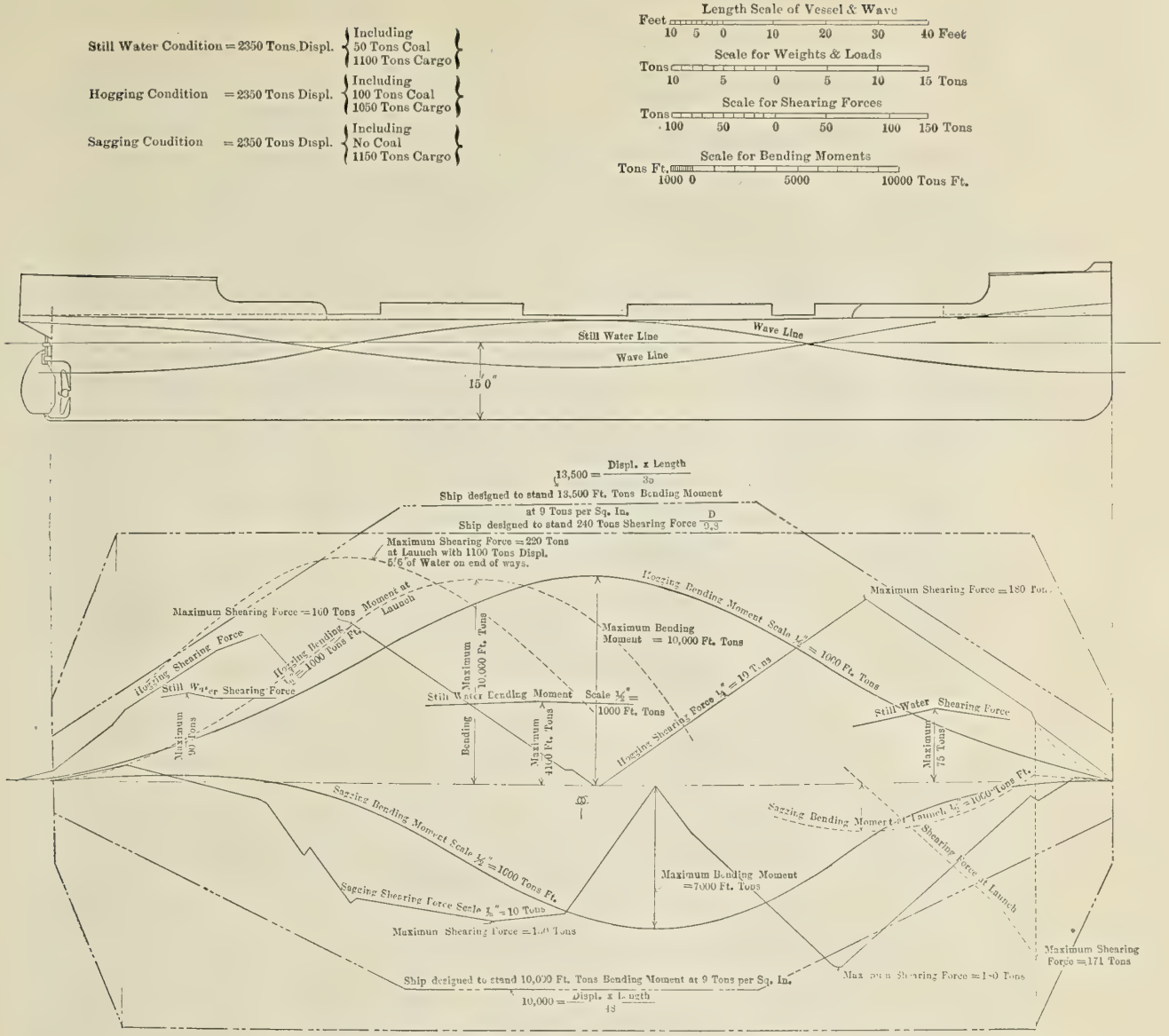

Still Water Condition = 2350 Tons Displ. { Including 50 Tons Coal 1100 Tons Cargo }
Hogging Condition = 2350 Tons Displ. { Including 100 Tons Coal 1050 Tons Cargo }
Sagging Condition = 2350 Tons Displ. { Including No Coal 1150 Tons Cargo }
Length Scale of Vessel & Wave
Feet 10 5 0 10 20 30 40 Feet
Scale for Weights & Loads
Tons 10 5 0 5 10 15 Tons
Scale for Shearing Forces
Tons 100 50 0 50 100 150 Tons
Scale for Bending Moments
Tons Ft. 1000 0 5000 10000 Tons Ft.
Still Water Line
Wave Line
Wave Line
15' 0"
13,500 = Displ. x Length / 30
Ship designed to stand 13,500 Ft. Tons Bending Moment at 9 Tons per Sq. In.
Ship designed to stand 240 Tons Shearing Force D/0.3
Maximum Shearing Force = 220 Tons at Launch with 1100 Tons Displ. 5/6 of Water on end of ways.
Maximum Shearing Force = 100 Tons
Moment at Launch
Hogging Shearing Force
Hogging Bending Moment Scale 1/2" = 1000 Tons Ft.
Still Water Shearing Force
Maximum 90 Tons
Maximum 10,000 Ft. Tons
Maximum Bending Moment = 10,000 Ft. Tons
Still Water Bending Moment Scale 1/2" = 1000 Ft. Tons
Bending
Maximum 4150 Ft. Tons
Hogging Shearing Force 1/2" = 10 Tons
Hogging Bending Moment Scale 1/2" = 1000 Ft. Tons
Maximum Shearing Force = 180 Tons
Still-Water Shearing Force
Maximum 75 Tons
Sagging Bending Moment Scale 1/2" = 1000 Tons Ft.
Sagging Shearing Force Scale 1/2" = 10 Tons
Maximum Shearing Force = 150 Tons
Maximum Bending Moment = 7000 Ft. Tons
Sagging Bending Moment at Launch 1/2" = 1000 Tons Ft.
Shearing Force at Launch
Maximum Shearing Force = 171 Tons
Maximum Shearing Force = 180 Tons
Ship designed to stand 10,000 Ft. Tons Bending Moment at 9 Tons per Sq. In.
10,000 = Displ. x Length / 48

Fig. 4.—Summary of Hogging and Sagging Stresses (Height of Wave, 1/20 Length)

going cargo vessel of reasonably large dimensions, to assure ourselves that such a vessel, constructed of ferro-concrete, would satisfy conditions of strength, seaworthiness, deadweight capacity, etc. The difficulties in the preparation of the design proved much greater than was anticipated, for while we, as shipbuilders, could prepare and supply the particulars and drawings of the vessel and approximate to the maximum stresses coming on the various members, we had no practical experience of the construction of the ferro-concrete part of the hull, so that it became necessary to work in conjunction with a reliable firm of ferro-concrete engineers, who would carry out this part of the design, basing it on work actually done. This association of shipbuilders and ferroconcrete engineers has proved mutually satisfactory and advantageous, and each party found that it had something to learn from the other with respect to shipbuilding of this type.

It was eventually decided that a self-propelled cargo vessel of about 1,150 tons deadweight was as large as we were justified in commencing as a first venture. It was agreed that the vessel should comply with all the requirements obtaining for steel vessels, and the general scheme was based upon that of a similar ship constructed of steel. The dimensions, for reasons which occurred in preparing the design, differed from those of a steel ship of the same deadweight carying capacity, especially in length. The dimensions and other particulars finally decided upon were as follows:

Length between perpendiculars	205 feet
Breadth molded	32 feet
Depth molded	19 feet 6 inches
Draft, when loaded	15 feet 6 inches
Indicated horsepower (about)	400
Speed (about)	7¾ knots

The following drawings indicate the general arrangement and other features of the vessel:

Fig. 1.—General Arrangement Plan.
Fig. 2.—Midship Section.
Fig. 3.—Sheer Draft or Lines Plan of the Vessel.

The various arrangement drawings were prepared and scantlings arranged in accordance with Lloyd's Rules for Steel Ships. Using these scantlings, a list was made up of the calculated section moduli of the various members. Upon these particulars the engineers prepared constructional sections, on the Hennebique principle of "equivalent strength," which were adopted as a basis for calculation of weights, etc.

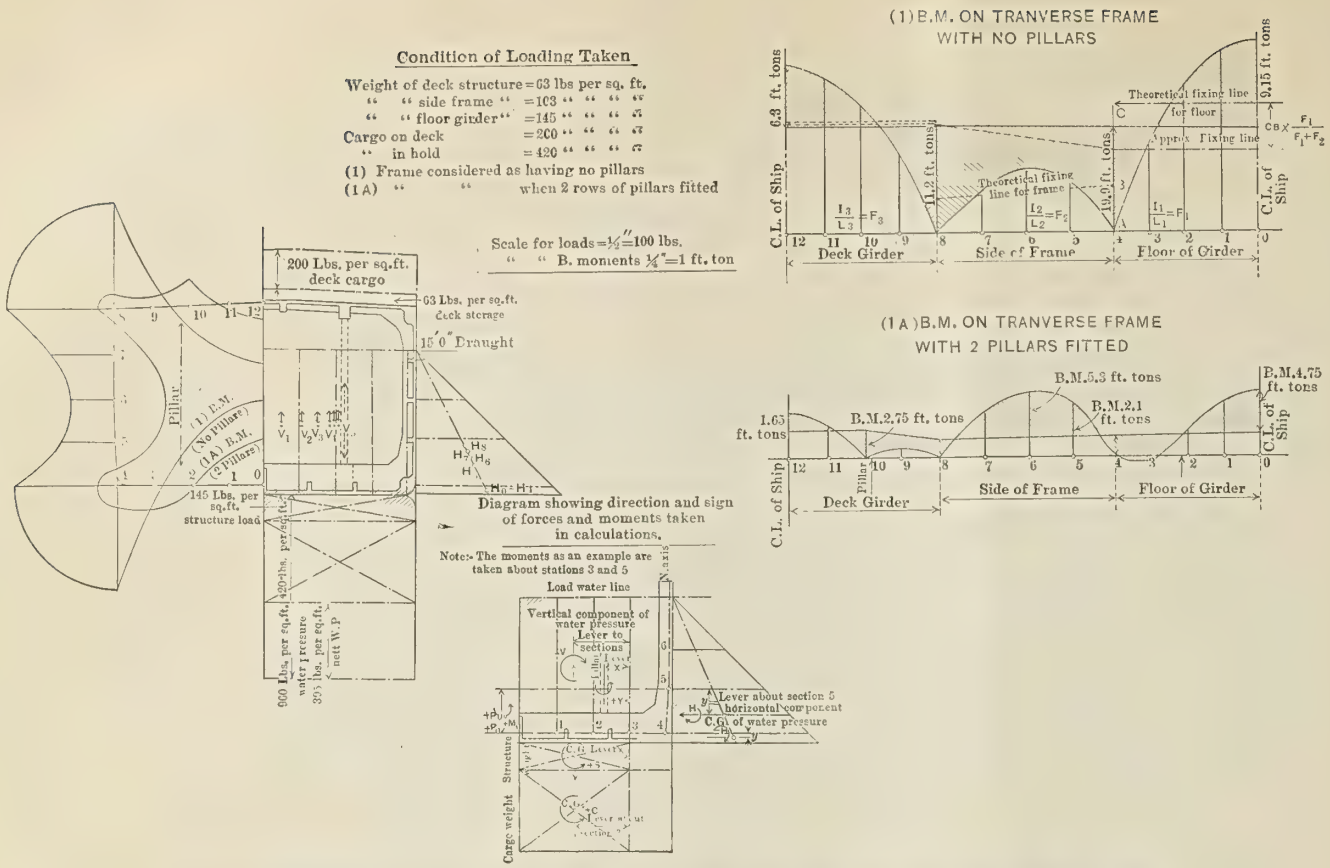

Condition of Loading Taken
Weight of deck structure = 63 lbs per sq. ft.
" " side frame " = 103 " " " "
" " floor girder " = 145 " " " "
Cargo on deck = 200 " " " "
" in hold = 420 " " " "
(1) Frame considered as having no pillars
(1A) " " when 2 rows of pillars fitted
Scale for loads = ½" = 100 lbs.
" " B. moments ¼" = 1 ft. ton
200 Lbs. per sq.ft. deck cargo
63 Lbs. per sq.ft. deck storage
15'0" Draught
145 Lbs. per sq.ft. structure load
Diagram showing direction and sign of forces and moments taken in calculations.
Note:- The moments as an example are taken about stations 3 and 5
Load water line
Vertical component of water pressure
Lever to sections
Lever about section 5 horizontal component
C.G. of water pressure
(1) B.M. ON TRANVERSE FRAME WITH NO PILLARS
6.3 ft. tons
9.15 ft. tons
11.2 ft. tons
10.9 ft. tons
Theoretical fixing line for floor
Theoretical fixing line for frame
Deck Girder
Side of Frame
Floor of Girder
C.L. of Ship
(1A) B.M. ON TRANVERSE FRAME WITH 2 PILLARS FITTED
1.65 ft. tons
B.M.2.75 ft. tons
B.M.5.3 ft. tons
B.M.2.1 ft. tons
B.M.4.75 ft. tons
Pillar

Fig. 5.—Transverse B. M. on Floor Girder, Side Frame and Deck Girder per Foot Length of Ship

The design was then carefully reconsidered and calculations made as far as possible for the stresses which the vessel would be subjected to, both longitudinally and transversely, under all reasonable conditions of construction, launching, and service.

One of the first things observed in the case of the ferro-concrete hull was that the center of gravity of the structural material worked out much lower than in the case of a steel hull, the result being a greater metacentric height than was desirable. To minimize this, the original beam of 34 feet was reduced to 32 feet, and in order to obtain the same hold capacity the depth was increased from the original 17 feet 6 inches to 19 feet 6 inches, fortunately, from the point of view of longitudinal strength, a modification in the right direction.

Lonitudinal Strength

In calculating longitudinal stresses the vessel was first of all assumed to be in still water with the holds loaded uniformly to the full-load condition, giving a dispacement of 2,350 tons. In this condition the maximum bending moment worked out at about 4,100 foot-tons. For hogging stresses the vessel was taken as being in the same load condition and on the crest of a trochoidal wave of length equal to the length between perpendiculars of vessel, and height equal to $\frac{\text{Length}}{20}$, giving a maximum shearing force of 180 tons and a maximum bending moment of 10,000 foot-tons.

In the sagging condition the vessel was much more severely loaded, three-fifths of the cargo being placed in the middle of the hold space, and one-fifth at each end respectively, resulting in a maximum shearing force of 180 tons and a maximum bending moment of 7,000 foot-tons.

In the case of launching, the maximum shearing force reached as high as 220 tons, with a maximum bending moment of 10,000 foot-tons. A generous margin was allowed over these figures, and the vessel was designed to stand the stresses corresponding to the following:

$$\text{Hogging moment, } \frac{\text{Displacement} \times \text{length}}{35} = 13{,}500 \text{ foot-tons}$$

$$\text{Sagging moment, } \frac{\text{Displacement} \times \text{length}}{48} = 10{,}000 \text{ foot-tons}$$

$$\text{Shearing force, } \frac{\text{Displacement}}{9.8} = 240 \text{ tons,}$$

the structural material being arranged so that the tensile stress on the reinforcement, taking account of all local stresses, never exceeded 9 tons per square inch, and the maximum compressive stress on the concrete 750 pounds per square inch.

Fig. 4 shows the longitudinal bending moment curves of the vessel in the various conditions.

Transverse Strength

In calculating transverse strength, the transverse framing was analyzed in order to ascertain the maximum bending moment to be resisted by the floors, frames, and beams under the various systems of loading to be met with in service.

The conditions assumed, for which calculations were made, are as follows:

(1) Vessel, without pillars, loaded to deep draft in still water. Cargo load in hold and on deck (see Fig. 5).

(1*a*) Vessel, with two pillars fitted, one at each side of hatch opening, loaded to deep draft in still water as in condition (1) (see Fig. 5).

(2) Vessel, with two pillars fitted, loaded as in (1),

and situated on wave crest, with no cargo on floor girder (see Fig. 6).

(3) Vessel, with two pillars fitted, loaded and situated in wave hollow with full cargo, load centrally placed below hatches and no deck cargo.

(4) Vessel, with two pillars fitted, in light condition, in dry dock, docked on center keel.

The calculations were investigated on the "principle of least work," taking the reinforced framing as monolithic.

In the moment as calculated there has been taken into account the stresses in the framing where only a partial support is received from the pillaring through the medium of longitudinal girders spanning between the transverse frames. The scantlings of the framing have been proportioned to the more severe conditions met with at the center of floor girders, bilge, side frame, deck corner, and beam.

It may be observed that if the floor girder is designed to resist the bending moment in condition (2), it is also strong enough to meet the docking condition in condition (4), where the bending moment is about two-thirds that of condition (2). In condition (3) the bending moment is reversed in direction and the floor tends to deflect downwards, caused by a bending moment approximately two-thirds of that causing the upward deflection in condition (2).

To provide an estimate of the bending moment to be allowed for in the first instance, the framing was treated as a continuous girder, and the free bending moment calculated for the several spans.

These were plotted on a straight base representing the neutral axis of the framing and the theoretical fixing moment lines drawn; at the points of junction between the floors, frames—where the amounts of the fixing moments varied—and beams, the difference in bending moment was proportioned to the expression $\frac{I}{L}$ of the member on each side of the joint.

Diagram 2 on Fig. 6 indicates the bending moments as estimated by the approximate method for condition (2).

Basis for Strength Calculations

As a basis for calculation of strength, the following were adopted as working limits for safe stresses on concrete and steel:

Concrete

Item.	Working Stress, Pounds per Square In.	Ultimate Stress, Pounds per Square In.
Compression in beams	750	4,000
Compression direct	700	4,000
Shear	70	280
Adhesion	60 100	240 500

Steel

Item.	Working Stress.	Elastic Limit.	Ultimate Stress.
Tension, spiral bars.	9 tons, square in.	23½ tons, square in.	30–36 tons
Tension, plain bars.	7½ " " "	15 " "	27–30 "
Compression	7½ " " "	15 " "	27–30 "
Shear	5½ " " "		24 tons

The vessels are, as before stated, in course of construction at Barrow-in-Furness, and the sand and aggregate found locally have proved most satisfactory for a concrete mixture suitable for shipbuilding. The concrete adopted is formed of a rich mixture of 1 part cement, 1.2 parts sand, and 2.4 parts granite aggregate (by volume). The cement used weighs 84 pounds per cubic foot. The sand used is of a coarse nature, having the following sieve test:

Mesh of Sieve	Remaining Percentage on Sieve
100 × 100 per inch	100 percent
50 × 50 "	61 "
20 × 20 "	14 "

The agregate used consists of granite chippings from ⅝ inch downwards, weighing 92.5 pounds per cubic foot. The proportionate amounts of cement, sand, and aggregate to form 27 cubic feet or 1 cubic yard of concrete are:

9 cubic feet cement, 10.74 cubic feet sand, 21.47 cubic feet aggregate = 1 cubic yard.
= 757 pounds cement + 1,192 pounds sand + 1,986 pounds aggregate = 3,935 pounds.
= .34 ton cement + .53 ton sand + .89 ton aggregate = 1.76 tons
Add to this .05 ton water = 1.81 tons per cubic yard of concrete.

For estimating purposes 1 ton of concrete contains .57 cubic yard = 15.4 cubic feet; or .192 ton cement, .300 ton sand, and .508 ton granite.

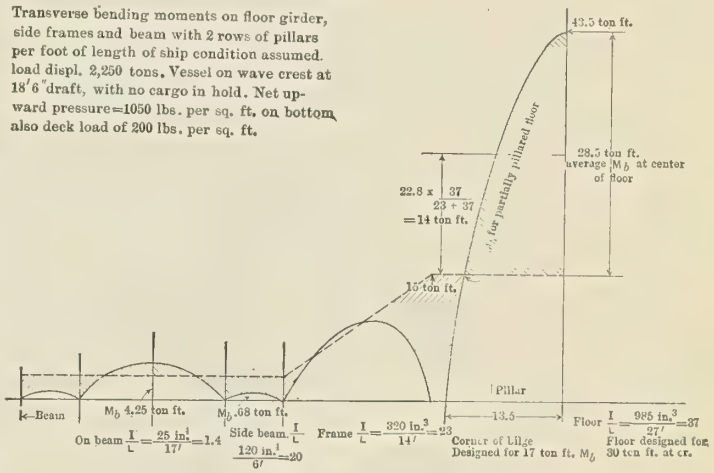

Transverse bending moments on floor girder, side frames and beam with 2 rows of pillars per foot of length of ship condition assumed. load displ. 2,250 tons. Vessel on wave crest at 18'6" draft, with no cargo in hold. Net upward pressure=1050 lbs. per sq. ft. on bottom also deck load of 200 lbs. per sq. ft.
43.5 ton ft.
28.5 ton ft. average M_b at center of floor
22.8 x 37/23 + 37 =14 ton ft.
15 ton ft.
Pillar
Beam
M_b 4.25 ton ft.
M_b .68 ton ft.
On beam I/L = 25 in.⁴/17' = 1.4
Side beam. I/L = 120 in.⁴/6' = 20
Frame I/L = 320 in.³/14' = 23
13.5
Floor I/L = 985 in.³/27' = 37
Corner of Lilge Designed for 17 ton ft. M_b
Floor designed for 30 ton ft. at cr.

DIAGRAM (2)
DIAGRAM OF BENDING MOMENTS & LOADS ON TRANSVERSE SECTION FOR 1 FOOT LENGTH OF SHIP

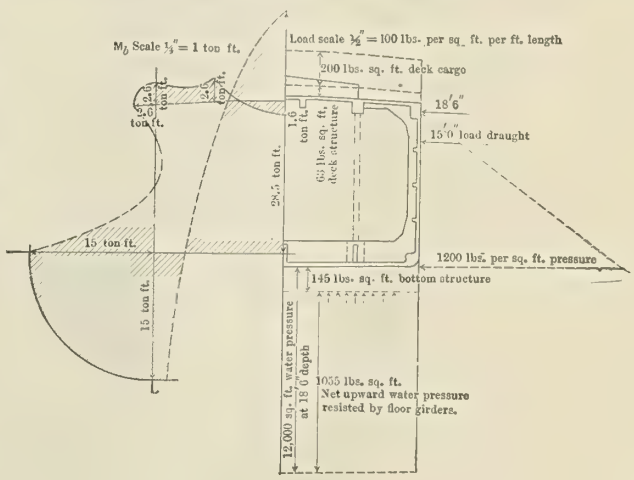

M_b Scale ½" = 1 ton ft.
Load scale ½" = 100 lbs. per sq. ft. per ft. length
200 lbs. sq. ft. deck cargo
18'6"
15'0" load draught
2.6 ton ft.
1.6 ton ft.
65 lbs. sq. ft. deck structure
28.5 ton ft.
15 ton ft.
1200 lbs. per sq. ft. pressure
145 lbs. sq. ft. bottom structure
15 ton ft.
12,000 sq. ft. water pressure at 18'0" depth
1055 lbs. sq. ft. Net upward water pressure resisted by floor girders.

Fig. 6

Machine mixing of concrete is preferable to hand mixing, inasmuch as a standard and invariable mixture may be obtained, due to the use of auotmatic devices for the

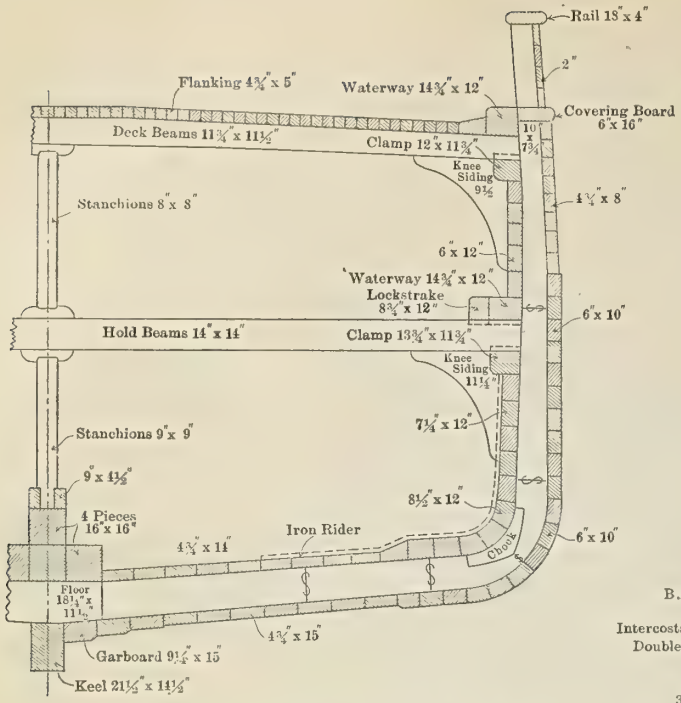


Fig. 7.—Wooden Cargo Vessel (1,150 Tons Deadweight), 205 Feet (B. P.) by 36 Feet by 18 Feet 9 Inches and 2,400 Tons Load Displacement. Midship Section Showing Scantlings for Spruce

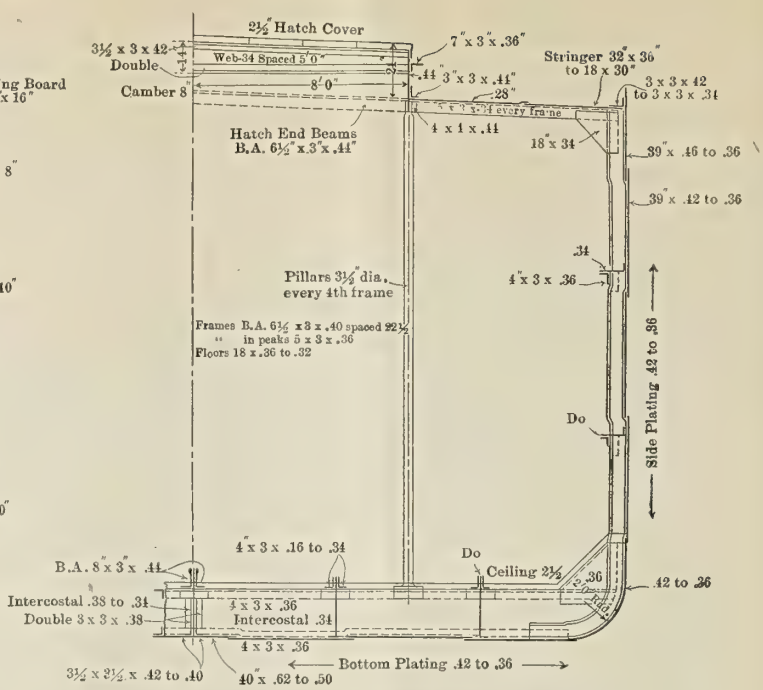

2½" Hatch Cover
7"x 3"x .36"
Stringer 32"x 36" to 18"x 30"
3½ x 3 x 42 Double
Web-34 Spaced 5'0"
Camber 8"
8'0"
44"x 3"x .44"
3 x 3 x 42 to 3 x 3 x .34
4 x 4 x .44
Hatch End Beams B.A. 6½"x 3"x .44"
18"x 34
39"x .46 to .36
39"x .42 to .36
Pillars 3½" dia. every 4th frame
4"x 3 x .36
Frames B.A. 6½ x 3 x .40 spaced 22½
" in peaks 5 x 3 x .36
Floors 18 x .36 to .32
Side Plating .42 to .36
Do
4"x 3 x .16 to .34
B.A. 8"x 3"x .44
Do
Ceiling 2½
Intercostal .38 to .34
Double 3 x 3 x .38
4 x 3 x .36
Intercostal .34
4 x 3 x .36
3½ x 3½ x .42 to .40
40"x .62 to .50
Bottom Plating .42 to .36

Fig. 8.—Cargo Steamer (1,150 Tons Deadweight), 188 Feet by 30 Feet 3 Inches by 17 Feet 3 Inches, Molded, Load Displacement 1,800 Tons. Midship Section

measurement of the various ingredients as well as of measurement of the time of mixing.

Particulars and Description of Hull

There are shown in Figs. 2, 7 and 8 three midship sections respectively for the ferro-concrete, a steel and a wooden ship, each designed for a deadweight carrying capacity of 1,150 tons. The particulars of the three ships are as follows.

	Reinforced Concrete.	Steel.	Wood.
Length	205 feet 0 inches	188 feet 0 inches	205 feet 0 inches
Breadth	32 " 0 "	30 " 3 "	36 " 0 "
Depth	19 " 6 "	17 " 3 "	18 " 9 "
Draft	15 " 6 "	14 " 6 "	*16 " 6 "
Deadweight	1,150 tons	1,150 tons	1,150 tons
Displacement (load)	2,350 "	1,800 "	2,400 "
Ind. horsepower.(about)	400	400	400

	Weights.		
	Reinforced Concrete.	Steel.	Wood.
Steel in hull†	190 tons	445 tons	140 tons
Remainder of hull	860 "	80 "	960 "
Machinery and boilers	80 "	80 "	80 "
Outfit‡	70 "	45 "	70 "
Deadweight	1,150 "	1,150 "	1,150 "
Load displacement	2,350 tons	1,800 tons	2,400 tons

* Includes 12-inch wood keel.
† Includes hull castings and forgings.
‡ Includes anchors, cables, boats, auxiliary machinery, etc.

It will be noticed that the weight of steel in the ferro-concrete ship is about 42½ percent of that in the steel ship. This is not by any means such a large reduction as some writers on ferro-concrete ship construction have anticipated, nor is it probably the minimum quantity which we could have adopted had we been prepared to incur a certain amount of risk in structural strength. In view, however, of this being our first venture in a new method of construction, we did not feel justified in reducing the strength until we had ascertained from experience how a ship constructed on this principle would act under ordinary conditions of service. One reason was that, should the vessel prove weak, it would be a matter of the utmost difficulty to introduce additional stiffening and strength. A second and even more potent reason was that we were not justified in risking the safety of the ship or the lives of the men who might navigate her, for the purpose of endeavoring in the first ship to reduce the quantity of steel that might be used to the minimum. Actual service will perhaps give an indication where weight may be saved, either in the steel or concrete of the hull; and that such saving will ultimately be effected, even with identical methods of construction, we confidently anticipate. It must not be overlooked that the saving of steel effected, especially under present conditions, is of the greatest importance. If we take, say, 200 vessels similar to the one under discussion, we should have an additional carrying capacity of 230,000 tons added to our mercantile fleet, while there would be a total saving of 51,000 tons of steel as compared with a similar number of steel ships of equal carrying capacity. Moreover, this steel is worked in the form of reinforcement rods and is not dependent upon the plate rolling mills for its production. This is the more important as at the present moment it is largely the limited output of the rolling mills which adds to the difficulty of procuring an adequate amount of shipbuilding steel.

We came to the conclusion that the most economical as well as the most efficient rod for ship construction was that known as the spiral bond bar. This is an ordinary mild steel bar, which subsequent to being rolled is stressed by being twisted in such a manner that the elastic limit is raised about 35 percent, the twist in the bar giving at the same time a continuous mechanical bond with the concrete in which it is embedded. With this high elastic limit smaller sections may be employed than would be possible with an ordinary mild steel bar, which means a

reduction in weight of steel used. As the continuous mechanical bond justifies shorter overlapping of bars at junctions, the weight of steel is again reduced. A further advantage of the special twisting treatment lies in the fact that steel of very low tensile strength may be thus treated, and so release for other important work the higher quality steel.

The following is a table of actual tests of a spiral bond bar (1⅜ inches diameter) before and after twisting:

Original Size.		Contraction of Area.			Elongation in 8 Inches.		Ultimate Stress.		Elastic Limits.	
Diameter.	Area.	Diameter.	Area.	Percent.	Inches.	Percent.	Actual Tons.	Tons Per Square In.	Actual Tons.	Tons Per Square In.
Before twisting, 1.375 ins...	1.39	.88	.568	59.2	10.40	30.0	37.4	26.9	24.5	17 62
After twisting, 1.375 ins....	1.39	.89	.581	58.2	9.68	21.0	41.3	29.7	33.2	23.86

See stress strain diagram, Fig. 9

Although the structure of these vessels, both in relation to the shell and frames, is purely reinforced concrete throughout, the possibility of working the shell of ferro-concrete vessels in conjunction with ordinary frame bars or built-up frames has not been lost sight of, although the problems attendant on such a departure from a purely monolithic structure present difficulties. It is conceivable that a vessel might be satisfactorily constructed in which the ordinary steel frame is used in conjunction with the present system of reinforced concrete hull, and in the United States they appear to have adopted some such method. With our present knowledge there would appear to be in this connection an element of danger unless a system is used blending together the parts in such a way as to leave no possible chance of disruption. The experience gained by American builders in this respect may help to solve this difficulty, as the principle, if successful, appears to be well worthy of adoption. It may indeed be essential in ferro-concrete ships of large tonnage. Such a system, too, would overcome some of the difficulties in connection with the fitting of various details which, at present, it is necessary to arrange before the concrete portion is commenced. A further advantage, and probably the principal one, is that, without having to introduce a much greater proportion of skilled labor, the system would result in a decreased weight of hull.

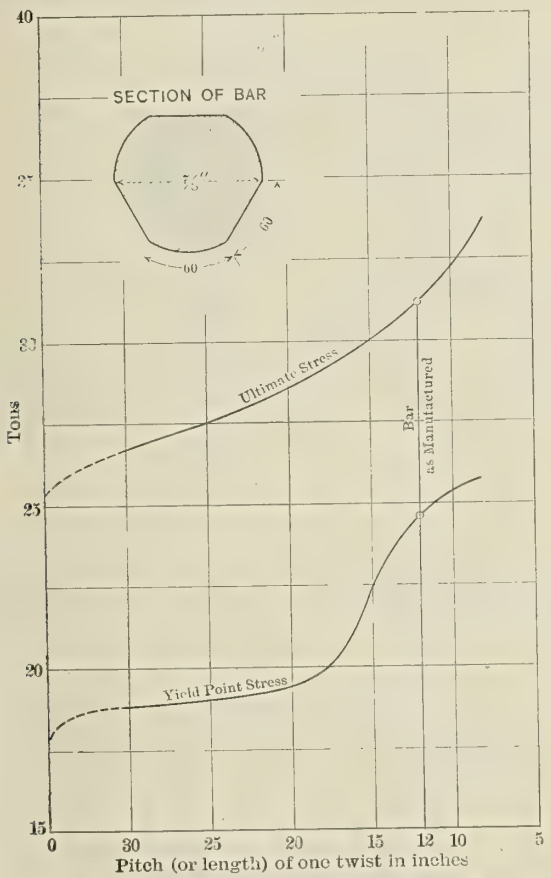


Fig. 9.—Curves Showing Comparison Between Rates of Increase of Yield Stress and Ultimate Stress for ⅞-Inch Diameter Bar, by Actual Test, of Pieces Cut from Same Bar but with Different Length of Twist

Hull Fittings and their Connection

Many problems have arisen regarding fittings and their connection and relation to the ship, which in ordinary steel construction are simple, but which, in the case of ferro-concrete construction, offer difficulties which have had to be carefully examined and overcome. Among these are the openings in the ship's bottom, stuffing-boxes, the passage of pipes through bulkheads, the connection of fittings to the bulkheads, and the connection of stanchions, fairleads, bollards, etc., to the deck. Added to these are important problems, such as the connection to the hull of

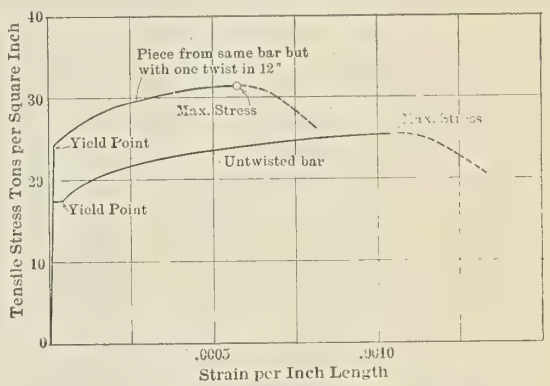

Piece from same bar but with one twist in 12"
Max. Stress
Yield Point
Untwisted bar
Yield Point
Tensile Stress Tons per Square Inch
Strain per Inch Length

Fig. 9a.—Stress-Strain Diagram for ⅞-Inch Diameter Bar, Before and After Twisting, Showing Respective Yield Points, Maximum Stress and Strain

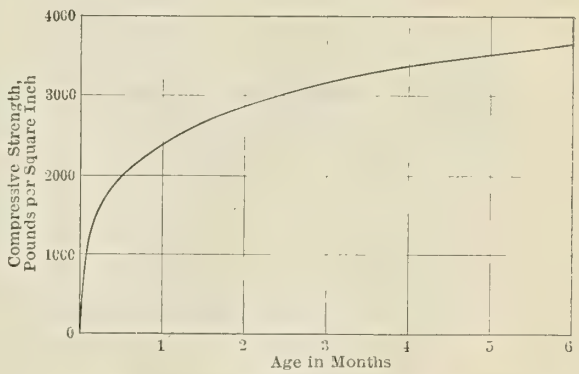


Fig. 10.—Diagram Showing Increase of Strength of Concrete with Age. Mixture (by Volume) of Concrete Used: Cement, 1.0; Sand, 1.2; Aggregate, 2.4

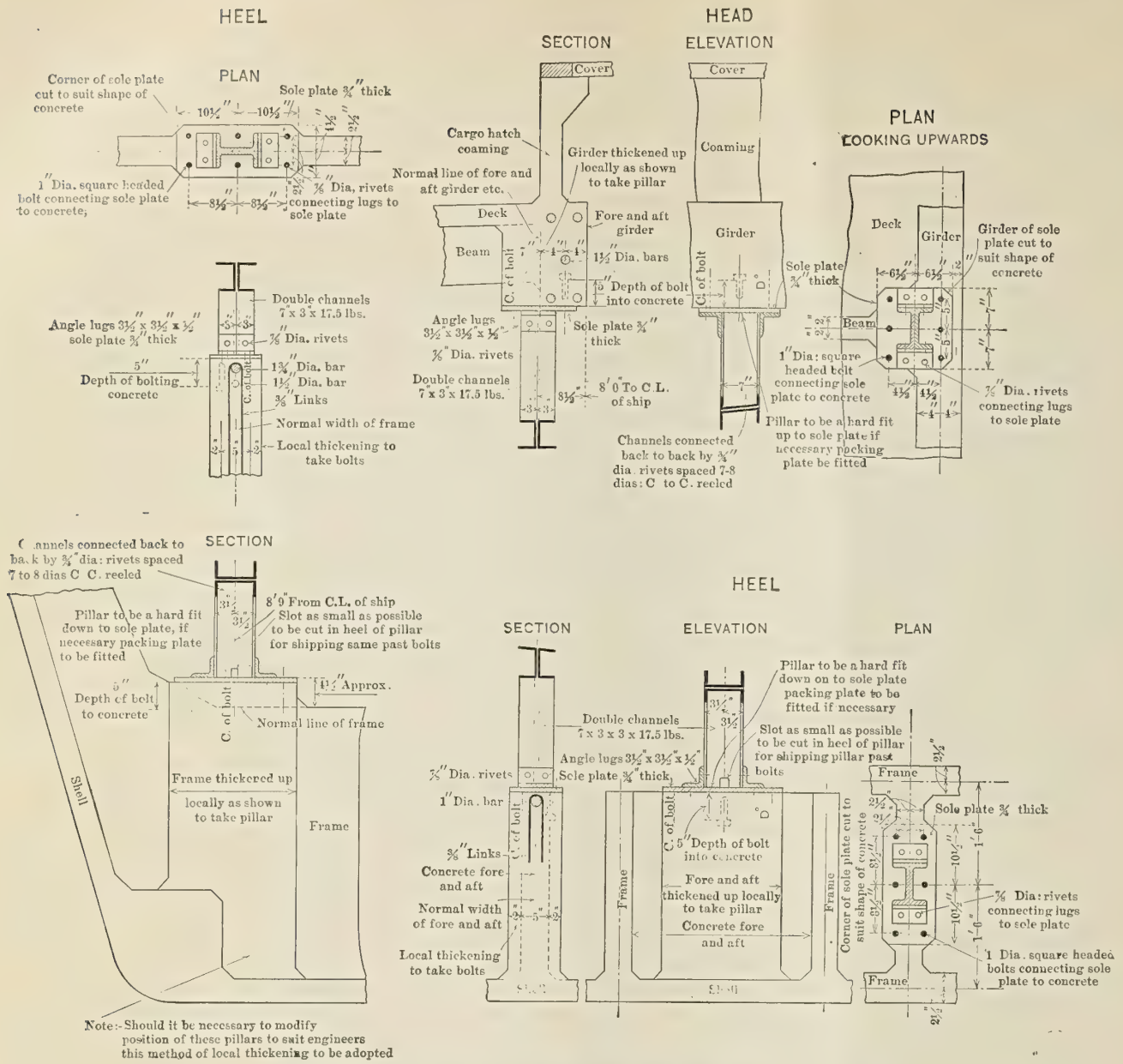

HEEL
PLAN
Corner of sole plate cut to suit shape of concrete
Sole plate ¾" thick
1" Dia. square headed bolt connecting sole plate to concrete;
⅞" Dia. rivets connecting lugs to sole plate
HEAD
SECTION
ELEVATION
PLAN
LOOKING UPWARDS
Cover
Coaming
Cargo hatch coaming
Girder thickened up locally as shown to take pillar
Normal line of fore and aft girder etc.
Deck
Beam
Fore and aft girder
1½" Dia. bars
Depth of bolt into concrete
Girder
Sole plate ¾" thick
Angle lugs 3½" x 3½" x ½"
⅞" Dia. rivets
Double channels 7" x 3" x 17.5 lbs.
8' 0" To C.L. of ship
Channels connected back to back by ¾" dia. rivets spaced 7-8 dias: C to C. reeled
Pillar to be a hard fit up to sole plate if necessary packing plate be fitted
Girder of sole plate cut to suit shape of concrete
1" Dia: square headed bolt connecting sole plate to concrete
⅞" Dia. rivets connecting lugs to sole plate
Angle lugs 3½" x 3½" x ½" sole plate ¾" thick
Double channels 7" x 3" x 17.5 lbs.
⅞" Dia. rivets
1¾" Dia. bar
1½" Dia. bar
⅜" Links
Depth of bolting concrete
Normal width of frame
Local thickening to take bolts
SECTION
Channels connected back to back by ¾" dia: rivets spaced 7 to 8 dias C C. reeled
Pillar to be a hard fit down to sole plate, if necessary packing plate to be fitted
8' 9" From C.L. of ship
Slot as small as possible to be cut in heel of pillar for shipping same past bolts
Depth of bolt to concrete
1½" Approx.
Normal line of frame
Frame thickened up locally as shown to take pillar
Shell
Frame
Note:- Should it be necessary to modify position of these pillars to suit engineers this method of local thickening to be adopted
HEEL
SECTION
ELEVATION
PLAN
Pillar to be a hard fit down on to sole plate packing plate to be fitted if necessary
Double channels 7 x 3 x 3 x 17.5 lbs.
Slot as small as possible to be cut in heel of pillar for shipping pillar past bolts
⅞" Dia. rivets
Angle lugs 3½" x 3½" x ½"
Sole plate ¾" thick
1" Dia. bar
⅜" Links
Concrete fore and aft
Normal width of fore and aft
Local thickening to take bolts
Depth of bolt into concrete
Fore and aft thickened up locally to take pillar
Concrete fore and aft
Frame
Corner of sole plate cut to suit shape of concrete
Sole plate ¾ thick
⅞ Dia: rivets connecting lugs to sole plate
1 Dia. square headed bolts connecting sole plate to concrete

Fig. 11.—Detail of Heads and Heels of Pillars

the rudder post, stern post, and the stern tube. In order to illustrate some of the difficulties experienced and some of the means adopted to overcome these difficulties, I have appended to this paper some sketches showing how certain of these questions have been dealt with, such as, for instance: Fig. 11—Arrangement of Pillaring. Fig. 12—Typical Spigot for Sea Connections. Fig. 13—Ceiling Plan.

There is no doubt that, with experience, improved methods of adapting fittings and parts of the structure to their proper functions in economical and efficient manner will be evolved, but for the moment we think that the methods adopted, as illustrated in the drawings reproduced, are such as to give reasonable justification for anticipating efficient performance. In the case of a steel ship, if before the erection of the bulkhead provision has not been made and holes punched to take any particular fitting, as, for instance, a bracket, it is an easy matter to drill such holes afterwards to accommodate it. For a concrete vessel, however, the cutting of holes after the concrete has set is not easy and is undesirable. It is, therefore, highly important that all the details of fittings required to be connected to the hull, or passing through a bulkhead, for instance, should be considered before the erection and casting of that bulkhead, and the necessary information must be ready at an early stage of the construction in order that the builders may make suitable provision for the same when erecting the shuttering. Where it is necessary to leave a hole in the concrete, a wooden peg may be fastened to the shuttering in the required position; but in the case of pipes passing through a deck or a bulkhead, a better arrangement is to cast a metal spigot in the concrete with

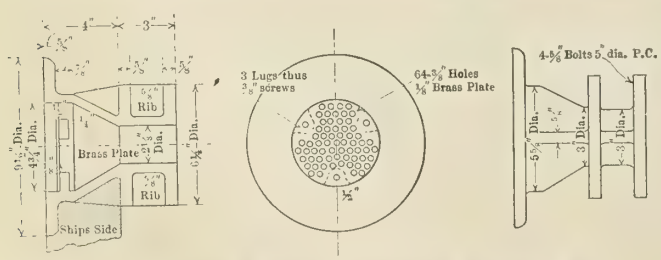


Fig. 12.—Typical Suction Connection on Ship's Side

suitable flanges or screwed ends projecting on each side for connection to the pipes. Such fittings as mooring pipes or hawse pipes, as well as the majority of small top-side fittings, have to be specially designed, with proper projections, for casting into the concrete, as otherwise holes must be prepared to take the holding-down bolts.

Lines and Tank Trials

It is obvious, in view of the fact that the whole of the vessel's hull has to be cast in molds or shutters, that the simpler and straighter the lines of the vessels the more cheaply and easily the shuttering can be constructed, and the more rapidly the work can be proceeded with. For this reason, when designing the lines, a simple midship section was adopted having a perfectly straight side and bottom with only a very small curvature at the bilge. This section was retained in a parallel middle body for half the length of the vessel amidships, and the waterlines forward rounded into an easy entrance, still retaining, however, the straight-line sections. In rounding in the waterlines aft the straight-line sections were retained as far as possible and then run aft to the propeller and faired in with a minimum of curvature.

In determining the form two points had to be considered:

(1) That the fullness of form which is economical in ordinary cargo boats when coupled with moderately low speeds would certainly be desirable when the material of construction was such that the weight of hull accounted for a larger proportion of the displacement than in the case of a steel ship.

(2) That the introduction of straight lines in the transverse sections, while desirable for constructional purposes, might lead to a large increase in resistance compared with an ordinary cargo boat form, if there were any tendency for the stream lines to flow across the knuckle (i. e., the intersection of the two surfaces forming the sides and bottom).

To obtain a reasonably good form under the above conditions, trials were carried out in the experimental tank as follows: The model was made fuller than was actually required and cast thick enough locally to allow cutting off at certain parts. After the curve of resistance had been obtained with the original model (C S), Fig. 14, the bottom part of the bow was fined (C S_2) with improved

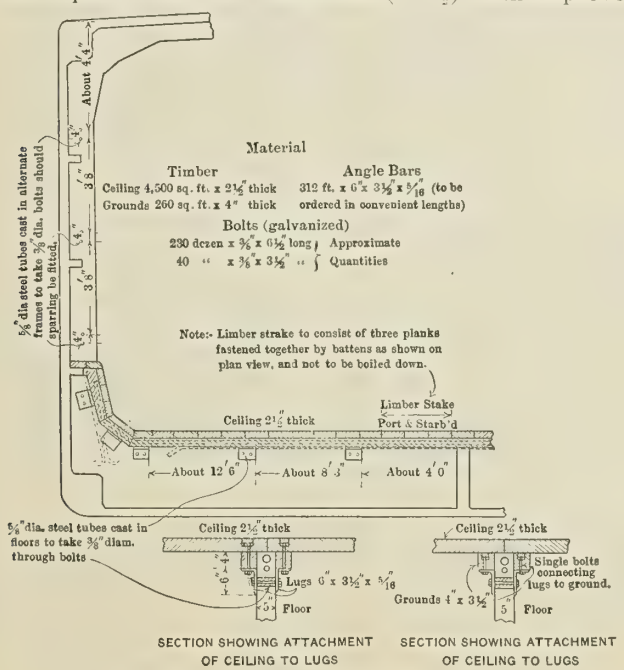

Material
Timber
Ceiling 4,500 sq. ft. x 2½" thick
Grounds 260 sq. ft. x 4" thick
Angle Bars
312 ft. x 6" x 3½" x 5/16" (to be ordered in convenient lengths)
Bolts (galvanized)
230 dozen x ⅜" x 6½" long } Approximate
40 " x ⅜" x 3½" " } Quantities
5/8" dia steel tubes cast in alternate frames to take ⅜" dia. bolts should sparring be fitted.
Note:- Limber strake to consist of three planks fastened together by battens as shown on plan view, and not to be boiled down.
Limber Stake Port & Starb'd
Ceiling 2½" thick
About 12'6"
About 8'3"
About 4'0"
5/8" dia. steel tubes cast in floors to take ⅜" diam. through bolts
Lugs 6" x 3½" x 5/16"
Grounds 4" x 3½"
Single bolts connecting lugs to ground.
Floor
SECTION SHOWING ATTACHMENT OF CEILING TO LUGS
SECTION SHOWING ATTACHMENT OF CEILING TO LUGS

Fig. 13.—Arrangement of Ceiling

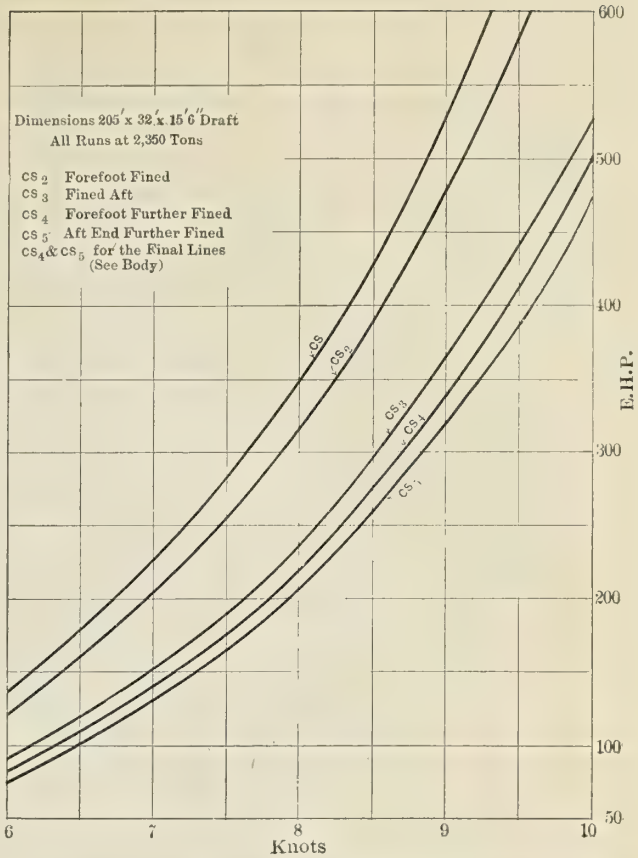


Fig. 14.—Tank Results. Model "C S" (Concrete Ship)

result. Then the after-body was similarly fined (C S_3) with further advantage. A further fining of the bow (C S_4) and then again of the stern (C S_5) still improved the form, which was now reasonably comparable with an ordinary cargo boat form of the same dimensions and displacement.

The total modifications made were comparatively slight, amounting to 23 tons, and reducing the block coefficient by .01.

The load waterline and curve of areas have generally been regarded as the determining features of the resistance of an ordinary form, but we found that the influence of the knuckle was so marked that, with the waterline unaltered and practically the same curve of areas, a reduction was made in resistance of 40 percent.

The lines plan, Fig. 3, shows in dotted lines the model as originally tried corresponding to the C S form on the tank results diagram, Fig. 14, and the full lines on the lines plan show the lines to which the ship is actually being built and correspond to the last trial in the tank and to the C S_5 form on the tank results diagram. It was not considered necessary to show the intermediate modifications on the lines plan.

The lines ultimately adopted may, therefore, very reasonably be considered as the most suitable for simplicity of shuttering and for easy construction in ferro-concrete.

The deck has a chamber of 8 inches in the full breadth: but here again curvature has been avoided, the crown being a level flat 4 feet each side of the center line, the remaining deck sloping in a straight line to the side, as shown on the lines plan, Fig. 3, and the deck at center is a straight line all fore and aft.

Propelling Machinery and Boilers

With respect to the propelling machinery, the considerations which have to be taken into account as to suitability of type are practically the same in ferro-concrete

as in steel ships; but the method of efficiently connecting the machinery to the hull of the ship, the arrangement of the stern tubes, the special attachment to the shell of sea connections, etc., require more consideration in the former case, and great care has to be taken to ensure reliability in this respect.

In the present six boats building to this design the adoption of machinery has been largely governed by what it has been possible to obtain under existing circumstances.

In three of the vessels we are fitting compound surface condensing single screw engines of approximately 350-400 horsepower with cylinders 17 inches and 34 inches diameter, 24-inch stroke, working at about 100 revolutions per minute.

The boiler installation consists of two cylindrical boilers 9 feet 6 inches diameter by 9 feet long, working at a pressure of about 130 pounds.

In the remaining three we intend fitting triple expansion engines of about 500 indicated horsepower, which will somewhat reduce our deadweight capacity but give an appreciable increase of speed.

Two boilers were decided upon, so that in the case of a breakdown of one there would be sufficient boiler power in the ship to drive the vessel at a reasonable speed. When in port one of the boilers will be of sufficient power to work all necessary auxiliary machinery, including that for loading or discharging. Incidentally, there are other advantages in having two small boilers, such as the possibility of their transport by rail instead of by sea from the place of manufacture to wherever the machinery is being installed. Further, the advantage of being able to ship the boilers through the hatchways, as leaving any part of the deck unfinished for this purpose, is very undesirable in ferro-concrete ships.

The machinery is fitted aft, a usual position in this type of cargo vessel; but another reason for this was to reduce the length of tunnel, as if this were of ferro-concrete instead of steel it would form an important item of weight.

Launching

Coming next to the question of launching, this is an operation which, in the case of ferro-concrete ships, requires more than ordinary consideration and care. This operation, always fraught with anxiety, is doubly so when dealing with a vessel of ferro-concrete construction. Take, for instance, the launching arrangements for the vessel under discussion. A launching weight of 1,100 tons has to be dealt with as compared with about 550 tons in the case of a steel ship of corresponding size. To keep down the stresses, a moderate declivity of ways with ample depth of water on the way ends has been arranged; but, even so, quite a considerable hogging stress and excessive way-end pressures are met with just before the stern commences to lift. Some internal shoring has to be arranged at suitable parts of the vessel as additional precautions before launching. The shearing forces at the fore poppet are severe and must be met by an adequate strength of hull.

The foundation supports, especially as the vessel is being built on new ground, have been carefully considered, as sinkage during any stage of the concreting would have serious results and must be guarded against.

The precaution of allowing the concrete sufficient time to set properly before the vessel is launched is necessary in view of the fact that the compressive strength of the concrete continues to increase for some time after being worked, and it is necessary to utilize as much of this increased strength as possible to resist the launching stresses. Fig. 10 shows this increase of compressive strength on a base of months.

The supporting blocks and holding-up arrangements (dog shores) also require greater strength than is necessary in the case of the lighter steel vessels. A sketch showing the arrangements made is given on Fig. 15, and shows very fully the practical arrangements as well as the curves of stresses under all conditions likely to be met with.

Generally speaking, the severe launching conditions may be taken as an adequate test of the vessel's ability to withstand any stresses she may be called upon to meet under ordinary conditions of service.

To obviate the undesirable necessity of pile-driving in the channel where the vessel is being built, the standing ways beyond the sea-wall are supported on specially designed pontoons resting on the bed of the channel. These pontoons are specially constructed of concrete and may be towed from one berth to another, and when in the necessary positions are sunk by being flooded through sluice valves arranged in the sides for that purpose (see Fig. 15).

Some statement should perhaps be made here as to the time for construction of vessels of this type as compared with steel ships, and our experience so far leads us to believe that in the case of the first vessel of any type, the time of construction approximates very closely to that of a steel ship, but that in building successive ships of the same size and form there will be a marked reduction owing to the possibility of using repeatedly a large proportion of the shuttering or molds. By this means I believe that, with all the material to hand, a vessel similar to that described in this paper could be completed in three and a half to four months.

I regret that neither time nor space allows me to indicate other types under construction in the yard, all possessing interesting characteristics. When completed their performances will no doubt add a helpful contribution to the study of ferro-concrete construction as applied to shipbuilding. Neither can I touch on the question of the application of discard steel for constructional purposes, as largely advocated by some builders, nor on the future possibilities of ferro-concrete as applied to shipbuilding when the time arrives when we shall not be driven to its adoption by stress of war conditions.

I admit some limitations in the paper, due to absence of precise knowledge and experience of the sea tests of the ships, but I hope to have the honor on another occasion of completing this contribution by giving the service results of the vessels described, when opportunity will probably occur to deal with other points omitted from the present paper.

In conclusion, I should like to express a word of thanks to those associated with me in this work: the members of the staff of the Ferro-Concrete Ship Construction Company, of Barrow-in-Furness, who have worked so energetically and untiringly in the design and construction of the vessels; and to the directors and staff of Messrs. L. G. Mouchel & Partners, who have brought great ability and experience to bear on the solution of some of the difficult problems involved; also to the directors of the Yorkshire Hennebique Company, who have by their experience shown us how, in many ways, the time of construction can be shortened.

A boiler is a means for converting latent energy into dynamic force. The quicker this can be done the more economical is the boiler.

If you have work to do in meters, centimeters and millimeters, forget that there are such measurements as yards, feet and inches. It will save you brain fag.

Supplem

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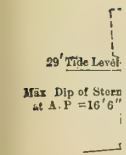
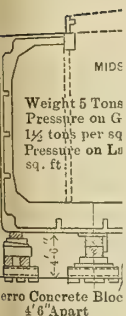

29′ Tide Level
Max Dip of Storm
at A.P =16′6″


MIDS
Weight 5 Tons
Pressure on G
1½ tons per sq
Pressure on Le
sq. ft.
erro Concrete Bloc
4′6″Apart

REINFORCED CONCRETE CARGO STEAMERS BUILDING IN GREAT BRITAIN

(From Paper by T. G. Owens Thurston before Institution of Naval Architects)

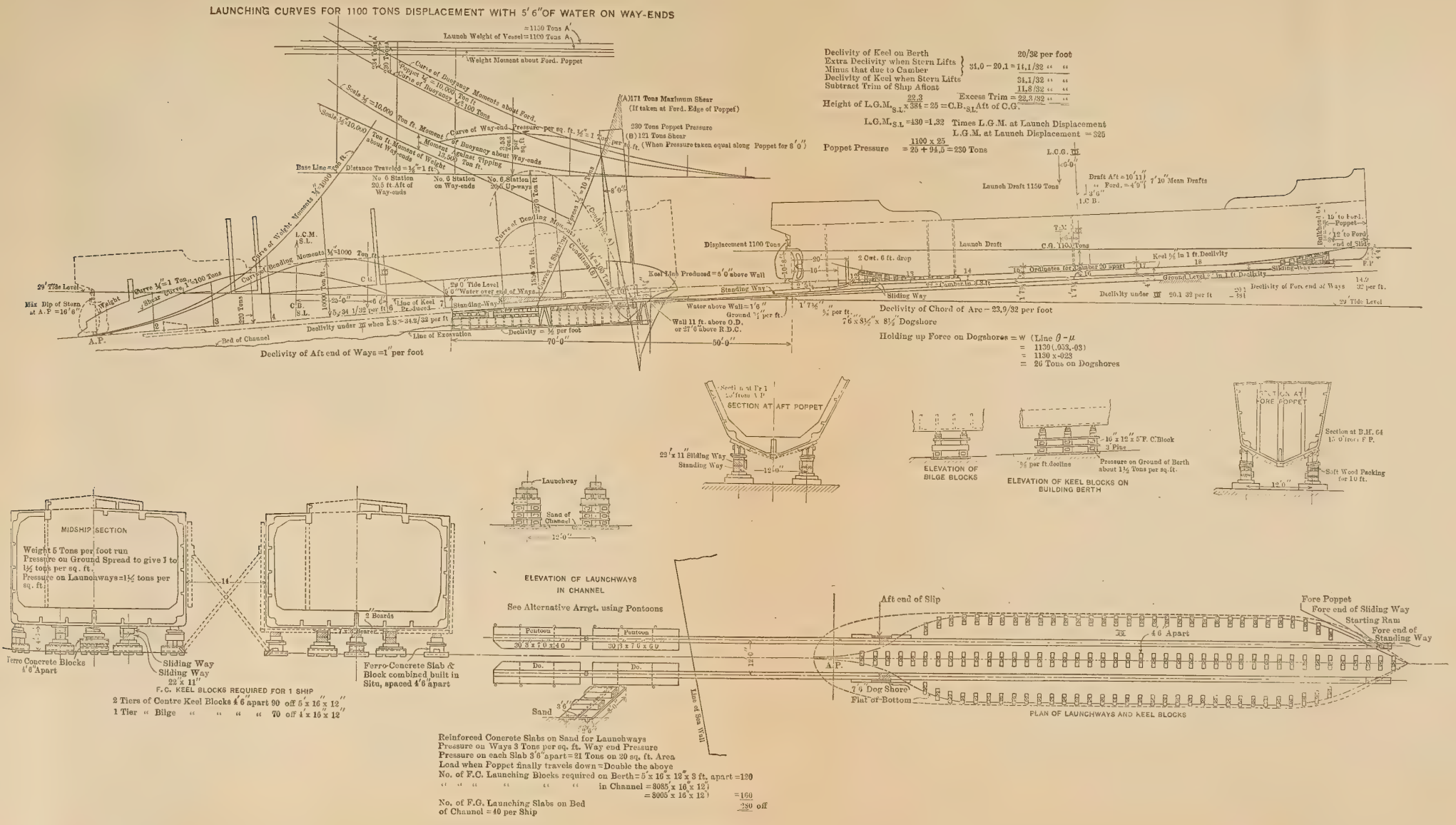

LAUNCHING CURVES FOR 1100 TONS DISPLACEMENT WITH 5'6"OF WATER ON WAY-ENDS
Launch Weight of Vessel=1100 Tons A'
Weight Moment about Ford. Poppet
Curve of Buoyancy Moments about Ford.
Curve of Buoyancy
Curve of Way-end Pressure
Curve of Buoyancy about Way-ends
Curve of Weight Moments
Curve of Bending Moments
Curve of Shearing Forces
Base Line
Distance Traveled
No. 6 Station 20.5 ft. Aft of Way-ends
No. 6 Station on Way-ends
No. 6 Station 20.5 Up-ways
(A)171 Tons Maximum Shear (If taken at Ford. Edge of Poppet)
230 Tons Poppet Pressure
(B) 121 Tons Shear
(When Pressure taken equal along Poppet for 8'0")
Declivity of Keel on Berth 20/32 per foot
Extra Declivity when Stern Lifts
Minus that due to Camber
31.0 − 20.1 = 14.1/32 " "
Declivity of Keel when Stern Lifts 34.1/32 " "
Subtract Trim of Ship Afloat 11.8/32 " "
Excess Trim = 22.3/32 " "
Height of L.G.M.S.L. x 384 = 25 = C.B.S.L. Aft of C.G.
L.G.M.S.L. = 430 = 1.32 Times L.G.M. at Launch Displacement
L.G.M. at Launch Displacement = 325
Poppet Pressure 1100 x 25 / 25 + 94.5 = 230 Tons
Launch Draft 1150 Tons
Draft A't = 16'11" Ford. = 4'9" 7'10" Mean Drafts
L.C.G.
L.C.B.
Displacement 1100 Tons
Launch Draft
C.G. 1100 Tons
2 Cwt. 6 ft. drop
Keel Line Produced = 5'0" above Wall
Standing Way
Sliding Way
Water above Wall = 1'6"
Ground 1/4" per ft.
Wall 11 ft. above O.D. or 27'0" above R.D.C.
Declivity of Chord of Arc − 23.9/32 per foot
Holding up Force on Dogshores = W (Line θ − μ
= 1130 (.053-.03)
= 1130 x .023
= 26 Tons on Dogshores
Declivity of Aft end of Ways = 1" per foot
Declivity = 1/2 per foot
Declivity under III when L.S. = 34.4/32 per ft
Declivity under III 20.1 32 per ft
Declivity of Fore end of Ways 32 per ft.
Line of Excavation
Bed of Channel
A.P.
F.P.
29' Tide Level
Max Dip of Stern at A.F. = 16'6"
Freight
Shear Curve
Line of Keel Produced
Standing Way
Sliding Way
Ground Level
Keel 5/8 in 1 ft. Declivity
Sliding Way
Section at F.P.
SECTION AT AFT POPPET
SECTION AT FORE POPPET
Section at B.H. 64
22'x11" Sliding Way
Standing Way
ELEVATION OF BILGE BLOCKS
16" x 12" x 5'F. C Block
3 Pile
3/8" per ft. decline
Pressure on Ground of Berth about 1 1/2 Tons per sq. ft.
ELEVATION OF KEEL BLOCKS ON BUILDING BERTH
Soft Wood Packing for 10 ft.
MIDSHIP SECTION
Weight 5 Tons per foot run
Pressure on Ground Spread to give 1 to 1 1/2 tons per sq. ft.
Pressure on Launchways = 1 1/4 tons per sq. ft.
2 Boards
Ferro Concrete Blocks 4'6" Apart
Sliding Way
Sliding Way 22'x11"
F.C. KEEL BLOCKS REQUIRED FOR 1 SHIP
2 Tiers of Centre Keel Blocks 4'6" apart 90 off 5'x16"x12"
1 Tier " Bilge " " " " 70 off 4'x16"x12"
Launchway
Sand of Channel
ELEVATION OF LAUNCHWAYS IN CHANNEL
See Alternative Arrgt. using Pontoons
Pontoon
Do.
Sand
Ferro-Concrete Slab & Block combined built in Situ, spaced 4'6" apart
Reinforced Concrete Slabs on Sand for Launchways
Pressure on Ways 3 Tons per sq. ft. Way end Pressure
Pressure on each Slab 3'6" apart = 21 Tons on 20 sq. ft. Area
Load when Poppet finally travels down = Double the above
No. of F.C. Launching Blocks required on Berth = 5'x16"x12"x3 ft. apart = 120
" " " " " " in Channel = 8085'x16"x12" = 8005'x16"x12" = 160
No. of F.C. Launching Slabs on Bed of Channel = 40 per Ship 280 off
Aft end of Slip
Fore Poppet
Fore end of Sliding Way
Starting Ram
Fore end of Standing Way
4'6 Apart
A.F.
7'0 Dog Shore
Flat-of-Bottom
PLAN OF LAUNCHWAYS AND KEEL BLOCKS

Fig. 15.—Launching and Berthing Plan

Length of standing ways, 313 feet by 6 feet; camber in 313 feet 22 inches; length and breadth of sliding ways, 164 feet by 22 inches; area of sliding ways, 600 square feet; launch displacement, 1,100 tons; weight on standing ways, 1,130 tons; pressure per square foot on ways, 1.88 tons per square foot; center of gravity aft of midship section, 6.5 feet; poppet pressure, 230 tons; moment against tipping, 13,500 tons; bending moment on overhanging stern, 10,000 foot tons; stress on concrete, 350 pounds per square inch; tensile stress on reinforcement, 5½ tons per square inch; minimum water on ways ends, 5 feet 6 inches.

Program of Power Plant Saving

STATE Administrative Engineers of the United States Fuel Administration held a conference in Washington on June 28 and 29, discussing the plan of organization in connection with conservation of fuel in power plants throughout the United States. The engineers appointed to date are:

Thomas R. Brown, Pittsburgh, for western half of Pennsylvania; formerly special engineer of Westinghouse Air Brake Company.

George R. Henderson, Philadelphia, for eastern half of Pennsylvania; formerly consulting engineer of Baldwin Locomotive Works.

Edward N. Trump, New York City, for state of New York; vice-president of Solvay Process Company.

W. R. C. Corson, Hartford, for New England; secretary, Hartford Steam Boiler Insurance Company.

Charles A. Cahill, Milwaukee, for Wisconsin.

Others at the conference were: M. S. Hopkins, Columbus, Ohio; O. P. Hood, Bureau of Mines, Pittsburgh; Prof. L. P. Breckenridge, Yale University; H. H. Stoek, University of Illinois.

The national programme will extend into all states east of the Mississippi, and include Louisiana, Missouri, and Minnesota. An administrative engineer will be appointed for each of the states in the area mentioned.

This plan is the result of conferences with the Federal Administrators and their committees for the group of states which together consume about seventy percent of all coal used in the United States, exclusive of railroads. The plan has received the endorsement of all of these states, as well as approval by the United States Bureau of Mines and the Committee of Consulting Engineers on Conservation and Publicity, which represents the Engineering Council of the four National Engineering Societies.

Maximum Production With Minimum Waste

The slogan of the campaign is "Maximum production with minimum waste." The object is to operate all industries at full capacity, but to make every pound of fuel perform maximum service. In laying the foundations for the organization it has been anticipated that this work should become a permanent service of the Government.

Ten to twenty percent, that is, from twenty-five to fifty million tons of coal per year, can be saved by correct operation of steam power plants, using their present equipment, and without installation of new apparatus. It is considered most important that all existing fuel conservation committees, committees of Chambers of Commerce and National Defense, Manufacturers Associations and other bodies be continued in full force, and that the cooperation of such organizations be obtained.

The administrative engineer in each state will work under the supervision of the present Federal Administrator. No separate or new organization is contemplated, but sufficient addition to the working force in each state will be made to insure efficient execution of the new function.

The National plan comprises certain fundamentals, as follows:

1—Personal inspection of every power plant in the country.

2—Classification and rating of every power plant, based upon the thoroughness with which owner of said plant conforms to recommendations.

3—Responsibility of rating the plants will fall upon the Administrative Engineer in each state; the rating to be based upon reports of inspectors, who will not express opinions, but will collect definite information. The State Fuel Administrator in his judgment may entirely or partially shut off the supply of coal to any needlessly wasteful plant in his territory.

4—Inspectors are to be furnished from one or more of the following sources:

A—Inspectors of the steam boiler insurance companies.
B—State factory inspectors.
C—Engineering students from technical colleges.
D—Volunteers and others.

The ratings will be based upon recorded answers to questions, each of which will be given a value depending upon its relative importance to the other questions. Depending upon the efficiency of methods in use in any plant, it may be rated in Class 1, 2, 3 or 4.

The Administrative Engineer in each state will have supervision of electrical and mechanical problems connected with fuel conservation activities contemplated under this plan.

Basis of Power Plant Ratings

The ratings will be based upon existing equipment. The difficulty, delay and expense involved in the installation at this time of improved power equipment are fully recognized; but experience has proved that ten to twenty percent of fuel now used in power plants can be saved by improvements in operation alone.

In advance of the first inspection a questionnaire is being sent to every power plant in each district, with notice to the owner that within, say, sixty days his plant will be inspected personally, and the questionnaire will be checked up by the inspector upon his visit. This action will give a reasonable time to any plant owner to improve the operation of his plant and conform to recommendations before his plant is actually rated. Thus, when the inspector calls for the purpose of obtaining and checking up the information form, the plant may receive a much higher rating than would have been the case if no time were allowed between the sending and collecting of the questionnaire.

It is recommended that a board of competent engineers be attached to the conservation committee in each state; also a corps of lecturers to arouse public interest and disseminate engineering information.

The Fuel Administration has prepared a fifty-minute film of moving pictures showing good and bad operation in the steam boiler plant, methods of testing boilers, etc. These pictures will be available to each state in connection with its educational propaganda.

The Administration is also preparing a series of official bulletins on engineering phases of steam and fuel economics. Some of these are now ready for printing. They will include:

1—Boiler and Furnace Testing.
2—Flue Gas Analysis.
3—Saving Steam in Heating Systems.
4—Boiler Room Accounting Systems.
5—Saving Steam and Fuel in Industrial Plants.
6—Burning Fine Sizes of Anthracite.
7—Boiler Water Treatment.
8—Oil Burning.
9—Stoker Operation.

In addition to this service, a list has been prepared in Washington of competent engineers for each state and is available for use of each local Administration. As the work develops, still further constructive assistance is contemplated for helping owners to bring their plants up to a high plane of economic operation.

How Can Soft Coal Be Burned Without Smoke in Marine Boilers?

Mechanical Stoking and Use of Pulverized Coal Advocated by Mechanical Engineers for Reducing Smoke on Steamships

AT the spring meeting of the American Society of Mechanical Engineers held at Worcester, Mass., June 4 to 7, sessions were held for the discussion of the subject of fuel economy, a subject of utmost importance this year as the country now faces a coal shortage of 80,000,000 tons. The question of how soft coal can be burned without smoke in marine boilers attracted considerable attention, as the avoidance of smoke on the transports and cargo vessels now carrying our troops and supplies to France would decrease the radius of visibility of these vessels by many miles and greatly reduce their liability to attack by submarines. If efficiency is thereby improved it means in this case much more than mere saving of coal.

Albert A. Cary, consulting engineer, New York, stated without qualification that the smoke nuisance can be overcome practically and satisfactorily without drastic changes from the present form of steam generating equipment. Two methods are available—either suppress the fires in the furnace by firing in such small quantities as to prevent the emission of smoke or secure complete combustion in the furnaces and combustion chambers. As the first method must result in a serious loss in the vessels' speed, the second method, in his opinion, gives the only rational solution of the trouble.

Mechanical Stoking

As an illustration Mr. Cary referred to an equipment for stationary boilers in which eighteen stokers had been operating 500 horsepower boilers 24 hours per day continuously for two years at 50 percent above their rating with average grades of eastern bituminous coal of no better quality than is used on transatlantic ships. They had been continuously burning from 42 to 45 pounds of coal per square foot of grate per hour with a clean smokeless chimney and have shown an easy forcing capacity when burning over 60 pounds of this coal per square foot of grate per hour.

The coal is fed by a mechanical stoker from a hopper to the fuel bed in a steady flow in such a manner as to avoid the trouble usually following its coke formation and the troublesome caking, and then it is moved along the grate automatically so as to constantly drop its ash directly down to the grate surface, where the cool entering air keeps the temperature of the ash below its fusing point, thereby avoiding the formation of obstructing clinker. The ash is dumped into an ash-sealed pit, where it is water-cooled and then carried forward into the front ash pit by an automatic device without disturbing the draft conditions of the furnace.

Only a light air blast pressure, seldom exceeding 1-inch water pressure, is necessary and this is supplied by an individual disk fan for each stoker requiring but little power to operate.

This method of mechanical stoking is suggested by Mr. Cary as a feasible means of reducing the smoke on vessets, although this equipment can be applied only to new vessels, as it is unsuitable for the average types of marine boilers with their present form of attached furnaces.

Osborn Monett, of the American Radiator Company, Chicago, declared that burning soft coal without smoke in marine boilers as a purely engineering problem is entirely feasible. Of the methods tried for this work the underfeed stoker probably has been best adapted and Mr. Monnett cited the following marine installations of the Jones underfeed stokers which are operating successfully to-day: The steamer *Sprague,* 6 Scotch boilers, 12 stokers; tug *Perfection,* 1 firebox boiler, 1 stoker; tug *Mollie Spencer,* 1 firebox boiler, 1 stoker; dredge *William O'Connell,* 2 double-end Scotch boilers, 8 stokers; steamer *Gamma,* 6 tubular boilers, 6 stokers; dredge *Hecla,* 2 Scotch boilers, 2 stokers; Ward Engineering Company steamers, 2 Ward watertube boilers, 4 stokers; Scandinavian steamer *Frederick VIII,* 8 Yarrow boilers 16 stokers.

As far as hand firing with Scotch boilers is concerned, experience, according to Mr. Monnett, has been discouraging, although he once succeeded in operating smokelessly a steamer so equipped, without any apparatus, simply by changing alternate fires. It happened that the boilers, two in number, were equipped each with three corrugated furnaces, all discharging into a common combustion chamber. The volatile matter from the fresh fire was consumed by the hot gases from the other two fires. With two furnaces the results would have been less satisfactory, and with separate combustion chambers (a common construction) impossible.

The idea in hand-fired furnaces has been to mix the gases, after they pass the bridge wall and while they are at a high temperature, with an auxiliary supply of air, and so accomplish complete combustion. Experiments have been made in Chicago harbor with brick arches, baffles and other constructions calculated to do this, but the small space available in the Scotch boiler has prevented satisfactory results. In fact, Mr. Monnett's experience with forced draft, induced draft, special air admission, preheated air, panel doors, steam jets, induction tubes, stack blowers, hollow bridge walls, etc., etc., has led to the conclusion, more strongly than ever, that some type of underfeed stoker is the logical answer to the Scotch boiler problem.

In watertube boiler construction, such as has been adopted by the Emergency Fleet Corporation, there is more opportunity to do things and it is not unreasonable to hope that a satisfactory hand-fired furnace for these units will be developed.

Lieutenant H. B. Oatley, U. S. N. R., chief engineer, Locomotive Superheater Company, New York, emphasized the difficulties of burning soft coal at or above the normal rate of operation with complete elimination of smoke. On new vessels the boilers, furnaces and uptakes can be so designed as to secure proper combustion, but on existing vessels unfavorable conditions may exist with respect to the proportions of air openings through the grates, volume of furnace and combustion chambers, area for gases through fire tubes and around watertubes and finally areas of uptake, breeching and stacks. The means for heating the air supplied in forced draft installations may also have been inadequately proportioned. While it is probable that to correct these conditions so far as the boiler itself is oncerned would be prohibitive on ac-

count of delay and expense in installing new boilers, nevertheless grates, uptakes and air admission generation may be corrected in a short time and at reasonable cost.

Above all, the personnel in the fireroom is a prime factor in dealing with this problem and great effort and expense are justified in giving all possible training to the fireroom crews.

Steam Economy a Big Factor

Lieutenant Oatley pointed out that steam economy is a big factor in the elimination of smoke because it results in reduction in the amount of fuel used and reduction in the rate of combustion. In the use of superheated steam, which offers an opportunity for reducing the fuel used by upward of 12 percent, and naturally a greater percentage reduction in the smoke produced, the marine boiler plants in this country are considerably behind the merchant marines in other leading countries. Superheated steam is particularly applicable to existing ships, as the necessary installation may be made at moderate cost during an overhauling. A reduction in the fuel used would make suitable many plants that have restricted areas through which the gases pass and permit of greatly improved combustion.

For existing ships Lieutenant Oatley believed there is a greater reduction in smoke to be expected by the more economical use of steam utilized under present conditions than by any other means.

Pulverized Coal

M. C. H. Hatch, of the Locomotive Pulverized Fuel Company, New York, stated that soft coal can be burned without smoke in marine boilers up to the point at which the furnace volume becomes too small to allow for proper air mixing and combustion space for the volatile hydrocarbons contained in the coal. Coal in pulverized form induces the desirable intimate mixing of gases and air very early in the process of combustion and less total air is needed per unit weight of fuel than with hand-firing. Basing his conclusion on locomotive and stationary practice, Mr. Hatch was positive that soft coal in pulverized form can be burned in marine boiler furnaces at much higher rates than can possibly be attained with hand-firing and that smoke will be eliminated or very materially reduced.

Henry Kreisinger also expressed the opinion that the best way of burning soft coal in marine boilers without smoke is to do away with hand-fired furnaces and use mechanical stokers or pulverized coal. For smokeless combustion, two requirements are essential: First, the volatile matter must be distilled at a uniform rate. Second, the distillation must take place in the presence of large amounts of free oxygen so that the volatile matter can be burned before the smoke is formed. These requirements are not satisfied in the hand-fired furnace. On the other hand, most of the mechanical stokers, as well as the powdered coal furnace, furnish means of satisfying these two requirements.

Most mechanical stokers feed the coal into the furnace at a uniform rate, so that the volatile matter is distilled also at a uniform rate. It is, therefore, comparatively easy to adjust a uniform supply of air to the volatile matter to insure its complete combustion without a too high excess of air.

Furthermore, with most of the mechanical stokers the air and the coal are fed into the furnace in the same direction, so that at the point where distillation takes place the air contains nearly 20 percent oxygen. On account of this large percentage of free oxygen the combustion of the volatile matter proceeds to completion without deposition of soot.

What has been said about the mechanical stoker is true of the pulverized-coal burner. The coal and air are fed into the furnace together at a uniform rate, so that the two can be easily adjusted to the proper proportion. The volatile matter is distilled from the small particles of coal, while the latter are surrounded with an atmosphere containing nearly 20 percent of oxygen.

With the pulverized coal a large part of the mixing of the combustible with the air can be done outside of the furnace. Thus the combustion space of the furnace needs to do only the burning and little mixing. Carrying on the mixing outside of the furnace deserves full consideration in the case of marine boilers, because the restriction of space on board ship makes large combustion chambers prohibitive.

Haylett O'Neill, who for the past two months has been running tests of marine boilers using pulverized coal at New Haven, Conn., stated that they had been able to burn this fuel without smoke and had obtained just as much speed and power as with the regular oil-burning equipment aboard the ship. The boilers were of the Normand express type with a very small furnace particularly unsuited to such fuel as powdered coal. Mr. O'Neill believed that the future will see much work done in marine practice in the way of substituting coal for oil inasmuch as fuel in the form of coal will cost about one-half or even one-third of what the oil will cost.

Plan for Simplifying and Standardizing Template Construction Suggested by Practical Shipbuilder*

BY FRED N. NELSON†

IN this national crisis, when ships are the Nation's first need, anyone who can save time in their construction and utilize the necessarily diluted labor to best advantage is performing a real service to his country. For that reason the following suggestion is offered in the hope that it may be found useful in simplifying and standardizing ship construction methods. No delays or radical changes are involved in the plan. It is simply an evolutionary improvement over old ways of doing things, a result of practical experience, and a proved success in saving time, money, tools, and material.

Outline of Plans

The improvement begins in the laying-out department, where the greatest saving is accomplished, reaching thence into the tool room and machine shop in connection with the manufacture of duplicating punches, many of which would no longer be needed by adoption of this plan. A very brief description of methods generally employed at present will help to a better understanding.

The evolution of shipbuilding has led to an ever-increasing proportion of the hull of the ship being developed in the mold loft and laid off from templates, showing all the details required. Practical shipfitters have followed their work into the mold loft and now make their templates there instead of "lifting" them from the ship as they used to do.

Care is Vital

It pays to do this work carefully, as every part developed must fit every other part, and mistakes mean

* From U. S. Employment Service Bulletin.
† Vice-president Seattle Metal Trades Council and now employed in the yard of Skinner & Eddy, Seattle, Wash.

wasted precious time and material. In these days of duplication of any number of hulls off the same molds, mistakes are multiplied in proportion; also, the same duplication makes it desirable and economical that the templates be as light and strong, simple and yet complete as possible for handling in laying off the work.

If the developing, making, marking, and checking of templates is done by ship-fitter loftsmen who know their business, who know how to make their templates "foolproof," a less skillful class of workmen can lay off the required number of plates, shapes, etc., without a reasonable excuse for making mistakes, one template perhaps, doing duty for various parts of the same hull and any number of hulls, all the details given on the template "foolproof."

This means a great deal in these days of abnormal demand for ships, and consequently for skilled men to build them. It saves mistakes and helps to solve the problem of making the really skilled men go as far as possible.

Wide Variation

The principal reason for this article is the fact that there is such a wide variation in the methods of various yards and sections in the construction and use of templates, which can be improved upon and save time in the construction of ships, and therefore have an important effect in winning the war.

The writer learned his trade at Bath, Me., when steel shipbuilding was in its infancy. Methods were crude, and nearly everything was "lifted." The custom there at that time was to mark location of holes with pieces of brass tubes dipped in whiting, which often gets rubbed off or misplaced, which causes omission of holes or holes punched in wrong places. Loft work was limited to fairing lines and making "scrieve board," besides templates for stem and sternpost, and later frames, though not on the universal system. The standard template wood used was three-sixteenths inch to one-fourth inch thick, of suitable width, mostly local pipe.

Best Kinds of Wood

Experience has taught us that templates made of Douglas fir or sugar pine are best, because these woods do not shrink or swell lengthwise, and therefore are not affected by moisture, like paper and other material experimented with. Also, work can be laid off more quickly and safely from wooden templates, and they can be stored away for years without changing.

Properly constructed they also stand rough handling, such as they are bound to get, especially where outside men work piecework.

At San Francisco the template wood used is similar, and the system there is to bore five-thirty-seconds inch holes for centers of holes, and the loft work is developed so that nearly all the hull is laid off from template furnished from the loft. The system is quite satisfactory, except that five-thirty-seconds inch holes make it necessary to "ring" the location and to first prick punch holes, then take the template off and center punch them, making two operations; also, the prick-punch marks being very light, holes are often missed, causing extra drilling and countersinking when work is assembled. The five-thirty-seconds inch holes were bored through templates in place on the floor with hand drills.

Seattle System

At Seattle the system in vogue was to bore templates the full size of the hole to be punched in the plates or shapes, which they thought made it necessary to make the templates of heavier wood, from three-eighths inch to one-half inch thickness, which made them very clumsy and hard to handle, and because of the big holes and the cut-outs leaving cross-grained pieces unsupported they were actually weaker than the templates made of lighter wood, which need not be cut-out except to working edges, and also can be more easily braced diagonally.

The chief objection, however, is the fact that this system required the use of duplicating punches of all the various sizes used, one type for wood for use in the mold loft, and other type for steel for use in the yard, of which each workman should have a full set, so that his time would not be wasted to borrow or steal the particular sizes needed.

The punches were too heavy to carry even one of them conveniently in the pocket. They are also quite expensive to make and easily spoiled; also the shoulder of the punch often catches on the side of the hole and tears the template when inexperienced workmen try to work fast. The output of the mold loft was often limited to the capacity of the boring machine, and at times templates otherwise ready to go out and needed were piled up for days waiting to be bored.

Improved Frisco System

Now the writer, on going to work in a new shipyard in Seattle, discovered an opportunity to improve on the San Francisco system without losing any of its advantages.

He saw that the center punching could be done with one operation by simply boring the holes ⅜ inch and touching up the center punch to fit that size hole. This simple act also disposed of the many sizes of duplicating punches and made the center punch, which a ship fitter always carries in his pocket, his duplicating punch for all sizes, for no matter how large or small the hole it is always punched from the center and the size is marked by the ship fitter. It also permits the construction of templates both lighter and stronger than the Seattle system previously used and saves lumber and tools; ¼-inch template wood is preferable, using ¾-inch tacks for nailing.

The holes can be spotted on the top template and bored through all adjoining laps, butt laps or butt straps, stiffeners, bounding angles, etc., in place on the floor most conveniently by using a small drilling machine, either air or electric, which all shipyards have nowadays. There are other minor advantages which for brevity's sake we will not mention, but which in the total count up.

How to Prevent Boring Floor

The ⅜-inch bitts are not as easily broken as the 5/32-inch and can be prevented from boring into the floor by slipping a piece of waste wood under template while boring and also by filing threads off, leaving the point. Boys quickly get to be experts at boring holes fair through several thicknesses at a time.

The plan is absolutely practical and will help solve the problem of utilizing the less skilled ship fitters to best advantage; it will save hundreds of thousands in money, tools, and materials, and save time, which cannot even be calculated in terms of money at this time.

The careful study of the walking beam of a beam engine shows most clearly the relation of strains to movements. The slower the movement the greater the strain on any part.

Why are the steep threaded bolts so much used in a shipyard for erecting not more frequently used in boiler work? They save time.

End-Launching of Vessel in Narrow Stream

Vessel Starting Down the Ways at High Velocity Brought to a Standstill at End of Ways by Unusual Means of Control

BY MAX HAUSEN*

THE launching of the S. S. *Beaumont,* the first Ferris type wooden steamship, built at the McBride & Law shipyard, Beaumont, Texas, which took place at 4 P. M., on Friday, June 28, was of special interest because of the difficulties that were encountered, due to the nearness of the opposite shore.

Because of the fact that the yard was located in the heart of the town, which afforded considerable advantage in the facility of the handling of materials, securing labor and affording protection, there were serious limitations as to the location of an advantageous position for launching

S. S. *Beaumont* Immediately After Launching

on account of railroad tracks and town sewerage lines which could not be removed.

The launching ways were laid at the greatest possible angle to the shore line which the above condition would permit, resulting in about 450 feet of water in line with the vessel, but, after deducting the length of the submerged ways, which was 130 feet, and that of the vessel, which was 270 feet, the remaining possible travel of the vessel after leaving the ways was only 30 feet, taking into account 20 feet of shallow water. These conditions made it apparent to the writer that the vessel would have to be stopped immediately after she left the ways. This result was successfully accomplished by utilizing several unusual methods as described below.

The keel was laid with a 5/8-inch grade. Due to the limited launching space the keel at the stern was laid as low as possible, about 3 feet above mean water level. Because of this, the ways were built with a slight crown, of about 12 inches, the highest point of which was drawn tangent to a 3/4-inch grade line at the rudder post, thus creating a declivity ranging from .642 inch to .804 inch, with a corresponding estimated free speed of from 4 feet to 22 feet per second. The momentum developed by the vessel going down the ways under these conditions would have been from 1,560 to 13,200 foot tons.

The above figures made it very apparent that it was hardly probable for the vessel to be successfully launched without retarding her speed. It was, therefore, decided to maintain a speed of from 7 feet to 10 feet per second, with a momentum of about 1,800 foot tons for three-quarters of the length of the ways and a gradual reduction of speed to a standstill at the end for the balance of the travel.

Braking Devices

This was achieved by means of a massive friction brake of live oak, with two 6-foot diameter wheels controlled by heavy steel brake bands. The brake was connected to the vessel with a 2-inch diameter steel wire cable. A bulkhead was also built at the stern below the arch, and this proved to be of considerable help in retarding the vessel.

As a further precaution two 2-ton anchors were buried about 8 feet in the ground and connected to the vessel by the anchor chain. They were controlled by the windlass on board the ship. Two 3-inch manila hawsers, fastened to the shore for holding the vessel, did not go into action.

Two extra anchors were dropped as soon as the vessel hit the water. Under pressure from the Government, the opposite shore was dredged out for 120 feet in line with the vessel. This, however, as the launching proved, was entirely unnecessary.

The actual launching proceeded in a manner slightly different from that originally contemplated, due to changes made in the control of the brake, which was changed from a one-man balanced level control to a triple block handled by ten men. The moment the dock shores were removed the vessel started, breaking the rope lashings around the ways. The unusually rapid start of the vessel was doubtless due to the perfect working of the launching grease.

Speed of Vessel Down the Ways

She gained a speed of about 11 to 12 feet per second in the first 120 feet of travel down the ways, when the order was given to the brakeman to check her. The instantaneous full application of the brake caused the 2-inch diameter steel wire cable to snap because of the lack of a sensitiveness in the sheave block control. The tearing of the cable, however, retarded her speed considerably. At this time the stern bulkhead met the resistance of the water, which slowed the vessel down still more, reducing her speed to about 4 to 5 feet per second in the next 100 feet of travel. At this point the anchor chains became taut, and, being intelligently controlled by the men handling the windlass, the paying out of the cable was gradually lessened until the vessel was stopped exactly as desired.

* Naval architect in charge of construction, McBride & Law Shipyard, Beaumont, Texas.

Taken altogether this was a most extraordinary launching, as the vessel, starting with a high velocity, was gradually slowed down until she passed over the end of the ways, when she was brought to a standstill. If the brake cable had remained intact a more perfect control would doubtlessly have been maintained over the vessel.

The *Beaumont* was built along the lines of the original Ferris type of construction; but reinforcements were built into the hull, as recommended by the American Bureau of Shipping, which make her one of the strongest of the vessels of this type that are being built. According to the chief surveyor of the American Bureau of Shipping, the *Beaumont* will receive the highest classification that can possibly be given to a vessel of this character.

Oregon Contributes First Wooden Steamship to Emergency Fleet

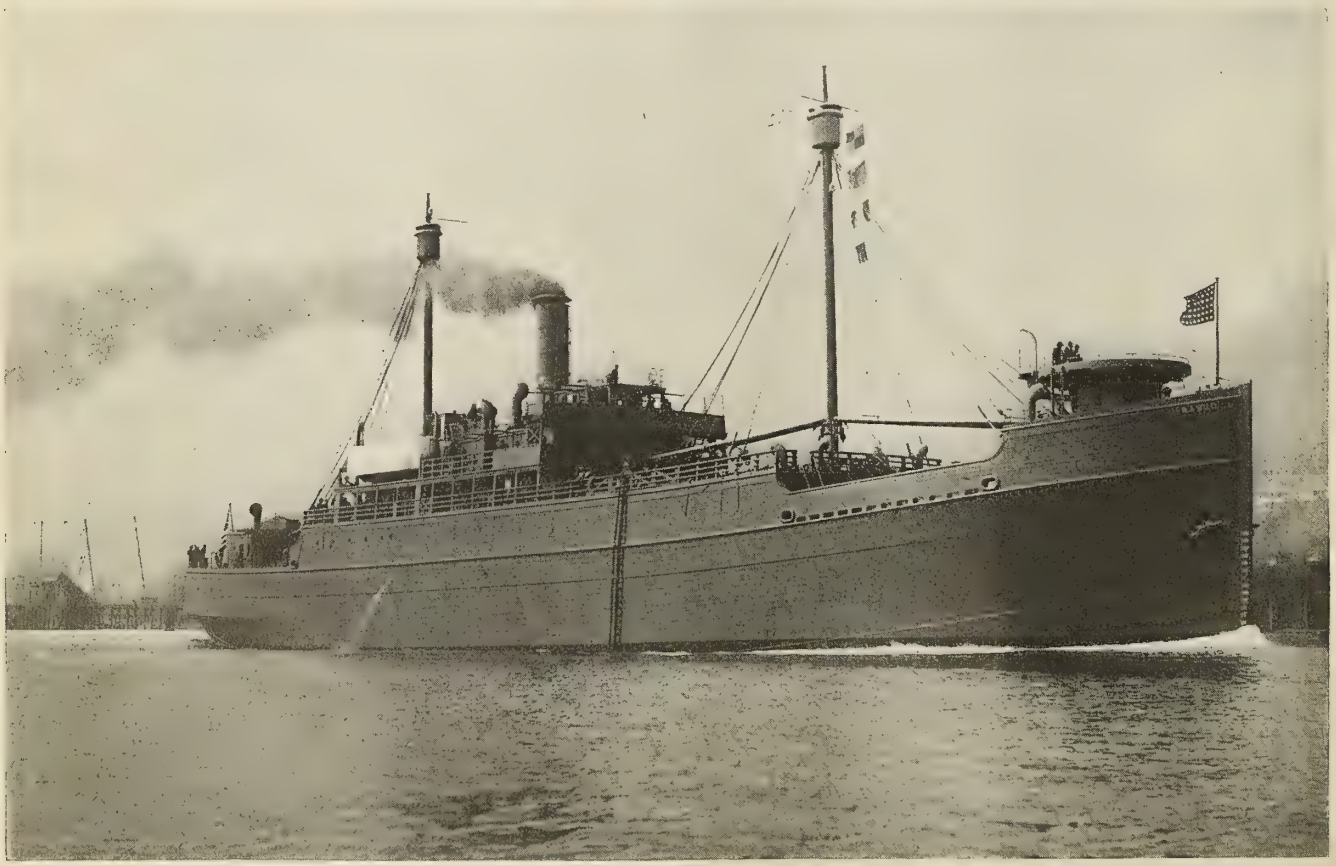
OREGON has gathered in the honor of delivering to the Emergency Fleet Corporation and sending to sea the first completed wooden ship of the mighty flotilla that will compose the merchant marine of the United States, and which is intended to aid in winning the war. The vessel was the *Wasco,* 286 feet in length, 46 feet beam, and capable of carrying 3,600 tons of freight under her hatches at a speed of 12 knots.

The big wooden freighter was registered under Government ownership at Portland, Ore., June 9, and left down the Columbia River for the open sea at 10:15 A. M., on Wednesday, June 10. Every item of equipment was in place and ready for use. The dates are particularly set down because it is an historic event. It was the first response to the undersea murder campaign of the Hun. It was the answer to President Wilson's call to labor. It was the contribution of a man who is building ships without retaining a nickel of the profits for himself, but who is putting portions of his private resources into Red Cross work and giving other sums for the relief of suffering among the allied nations and to the support of government activities.

Doubtless there are other American citizens who are backing the boys in the trenches as is Eric V. Hauser, hotel man and contractor, and their stories ought to be told for the encouragement of American spirit. The stories of such work are worth telling. Portland and Oregon were first over the top in the Third Liberty Loan drive because of having organized a working machine in advance of the date for securing the money. Mr. Hauser gave Portland the honor of furnishing the first wooden ship to the government because of having organized his shipyard into a machine for whipping the everlasting tar out of Germany.

So earnest are the men that they delivered four more wooden ships to the Emergency Fleet Corporation before July 10. They are the *Biloxi, Kasota, Blandon,* and *Boilston.* The *Biloxi* was delivered to the Government under full steam and in complete operating condition on June 18, nine days after the *Wasco* was delivered. These vessels are sisters to the *Wasco* and of the same type and size. Seven others are in the water and men are swarming over them in the work of fitting their equipment.

Enthusiasm is the keynote of operations at the shipyards where those boats were constructed. Heavy timbers swing into place to the music of popular war songs as whistled by the men. Mechanics are on edge to get their particular job completed because they realize that the boat on which they work is needed to carry forward the supplies the army wants, and because the people of Portland honor the men in the shipyards as they do the



S. S. *Wasco,* First Wooden Ship to be Fully Equipped and Turned Over to Emergency Fleet Corporation, Built at Portland, Ore., by Grant Smith-Porter Company

men in the trenches. That combination of workers and sentiment is what is going to give the Emergency Fleet Corporation a fleet within the next six months.

So strong is their belief in themselves that the men of the Hauser shipyard have placed a certified check for $10,000 (£2,050) in the hands of Meyer Bloomfield, of the Fleet Corporation, to back up their claim that they can build more ships and build them faster than any other wooden shipyard in America. These men are the sort of fellows who "eat this war stuff."

When a Red Cross subscription is announced, or a liberty loan, the shipyard workers say "How much from us?" Then they set aside so many days' pay for each man. And just inside the front gate of the big yard is a liberty rail, painted red, white and blue. On it any slacker is ridden from the enclosure.

It was not always thus. In the summer of 1917 Eric V. Hauser happened to be living in the big fir district of America when the necessity for wooden ships was announced from Washington. He had retired after years of railroad building as a member of Grant Smith & Company, of St. Paul. Mr. Hauser had no shipbuilders at hand, but he knew the men of the old Grant Smith crew.

Starting the Shipyard

Messages over the wires brought them together at Portland. They looked at the plans for a wooden ship of the Hough type, and said they could build it. Mr. Hauser took their word for it, and accepted contracts from the government for about thirty ships. In September the keels were ready to be laid down; but workmen who had been assembled got some kind of a grievance in their minds and went on strike with shipyard workers at other plants.

After the men went back to work in November, 1917, Mr. Hauser devised a plan to put them on edge, give them "pep" and make them see the importance of their labor in the great scheme to win the war. He arranged for the foremen of each shift to meet him at luncheons and dinners. At those dinners he convinced the men of his friendship and interest in their prosperity; he had Dr. William T. Foster, among others, tell them of the horror he had seen along the German trail in Belgium and in France; soldiers from the front told the shipbuilders their stories, and every speaker asked for ships, and quick delivery.

Out at the yards a band was organized to entertain the men during luncheon hours, several times each week patriotic speakers addressed the men; baseball teams were organized; a newspaper was printed carrying only shipyard news; bonuses were furnished workmen who were drawing a minimum of $3.25 (13/6½) and a maximum of $6.00 (1/5/0) each day; a community house was constructed where the men are given shower baths, amusements, and lockers for their clothing.

The *Wasco*, the first ship delivered to the Emergency Fleet Corporation, and her sister ships are the first syllable of the answer the men made. When the representatives of the Emergency Fleet Corporation, Lloyd J. Wentworth and J. W. Hall, cast loose the hawser and seized the halyards to raise the pennant of the corporation over the first wooden ship to be delivered to the Government, 3,000 workmen stood on the wharf and clung to the frames of embryo ships on the ways to cheer the departure of their first gift to Uncle Sam. They were proud of it.

Round corners on the top and bottom of a tap require a specially formed tool. Such a tool is expensive and not easily produced by the ordinary tool maker.

Shipbuilding in Japan*

JAPAN'S mercantile marine now well exceeds 2,000,000 tons. The official figures for the end of 1916 gave 2,170 steam vessels, aggregating 1,704,785 tons, and 9,187 sailing ships of 572,403 tons. In 1916 the Japanese yards completed 250 merchant vessels of 246,000 tons—more than twice the tonnage attained in any previous year—and when the figures for 1917 are available it will be found that the 1916 output has been much exceeded, in spite of the great difficulties in the way of importing materials.

Japanese shipbuilding owes much to State assistance. As recently as 1894, only 84 steamers of 1,000 tons or more were owned in Japan, and of these only one had been built in that country. But in 1896 the twin trades of shipping and shipbuilding received a great stimulus by the enactment of the now famous Shipping and Shipbuilding Subvention Law, which became operative in 1897. In the last year preceding the payment of subsidies the total output of Japanese yards was only 5,860 tons of steam and 1,061 tons of sailing (ocean-going) vessels. By 1900 the tonnage launched had increased to 15,380 steam and 17,873 sailing. For 1913, the last year before the war, the total output was 63,664 tons, nearly all steam. In 1914 the tonnage was 85,861; in 1915, 106,388; in 1916, 246,000; and last year something considerably over that tonnage. For 1917 the vessels completed under the terms of the Subsidy Law—that is, ships of not less than 1,000 tons—numbered 69, with an aggregate tonnage of 299,684 tons. It is estimated that with small craft, together with wooden ships of 1,000 tons or more not entitled to subsidies, the total output for the past year will have been at least 400,000 tons. On January 1, 1918, there was under construction in Japanese yards not less than 1,330,000 tons, though building was being delayed through shortage of materials, and many berths were empty. Japan now ranks third in tonnage built, and fifth in tonnage owned, amongst the world's nations.

New Subsidies Act

Under the Subsidies Law the output of the yards increased from 13,000 tons in 1897 to 78,000 tons in 1908, the subsidies in respect of both shipping and shipbuilding having increased in that period from 1,944,000 yen to 13,166,000 yen. In the next year, 1909, the output declined to 55,000 tons—a decrease of 23,000 tons on 1908. That was considered unsatisfactory, and a new Subsidies Act was carried. This came into force at the beginning of 1910, and the twin trades received a fresh impetus. The new law was framed to give smaller subsidies in respect of navigation, or shipowning, but more liberal terms in respect of the building of large vessels. Bounties of from 11 yen to 22 yen per ton of gross measurement were paid in respect of steel ships of not less than 1,000 tons, according to type, with an additional bounty upon the engines of 5 yen per indicated horsepower. Under the old law the bounty was a round 20 yen per ton for vessels of not less than 700 tons gross.

The new law aimed at the maintenance, or development, of certain specified trade routes, and the encouragement of larger and faster ships. It left the Minister of Communications discretion to refuse bounties to vessels of less than 3,000 tons if they were of less than 12 knots speed, or were employed upon undesirable routes. He was also empowered to grant increased rates of bounty up to 25 percent on the base in respect of vessels run on

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* From *Engineering*.

trades which might not be profitable, but which it might be specially desirable to maintain for Imperial reasons. An age limit was also imposed; and speed was considered. Ships built of steel in Japan, and owned in Japan, of not less than 3,000 tons gross, of not less than 12 knots, and not more than five years old, were subsidized at a rate of 50 sen—that is, half a yen, or about 1*s.*—per ton per 1,000 nautical miles' run. For every knot of speed beyond 12 per hour there was a bonus of 10 percent on the base bounty. On the other hand, when a ship exceeded five years of age there was a 5 percent reduction for every year until fifteen years were reached, when the subsidies might be withdrawn by the Minister of Communications. The Ministry was also authorized to grant subsidies at half the ordinary rates to foreign-built vessels if he thought fit. In the twenty-one years in which the Subsidies Act was in force the amounts paid totaled 160,000,000 yen—say, 16,000,000*l.* Recently—with the shipowners enjoying abnormal profits on account of the war, and in view of the high prices they are prepared to offer for new vessels—a new law has been carried suspending the payment of the subsidiès in respect of the building of ships. The Osaka Shosen Kaisha, owning 378,000 tons of shipping, and with a paid-up capital of 3,106,250*l.*, had a profit of 1,834,724*l.* for last year, after allocating 121,500*l.* to the insurance fund, 162,000*l.* to the repair fund, and 101,000*l.* for depreciation of the fleet. Generally the profits of Japanese shipping have been, to quote *The Financial Review of Reviews,* "immense."

Japan's Shipbuilding Resources

Regarding the rapidly increasing shipbuilding resources of the "Britain of the East" it may be mentioned that the country has about 120 berths capable of taking vessels of 1,000 tons or more. The capacity has been increased threefold since the war started. Perhaps the most notable of the Japanese shipyards is the one on Nagasaki Harbor, founded by the Government in 1857, but sold to a private capitalist in 1884. Shortly after the establishment of this State enterprise two or three yards and engine works were started by private people, but little or no financial success was met with. In 1868 the Imperial yard was placed under the management of an Industrial Department specially formed for the purpose. This body went in for merchant as well as naval building. Then a second Imperial yard was started at Kobe, and the best of the private plants were nationalized. The builders of fishing and other small craft tried to approach the Western style of construction, but the financial results were mostly disappointing. As mentioned above, in 1894, out of 84 Japanese steamships of 1,000 tons or more, only one had been built in Japan. But the Subsidies Law changed the situation. However, in 1884 the Imperial yard at Nagasaki became the private property of Baron Iwasaki, and is now known as the Mitsu Bishi Works. When it was denationalized in 1884 it employed 800 men, after twenty-seven years of State control. When the present war broke out it employed about 10,000 men. Last year this company launched 10 steamers ranging from a tonnage of 3,163 to 7,317. At the beginning of this year the firm had 13 steamers of an aggregate tonnage of 63,000 on hand. Before the recent war-time extensions, the principal yard of this concern covered 115 acres, it had nearly 1½ miles of water frontage, three dry docks of 350 feet, 510 feet and 714 feet in length, a patent slip 750 feet long, and seven building berths ranging from 185 feet to 700 feet long. Ten years ago this firm built two of the finest turbine passenger vessels of the day. The company has another yard at Kobe.

The principal yard of the Kawasaki Dockyard Company, at Kobe, like that of the Mitsu Bishi, was originally founded by the Government, but sold into private hands in 1886, and subsequently passed to the present ownership in 1896. Until about ten years ago only torpedo craft and small gunboats were built here for the Japanese and Chinese Governments, but in 1908 two merchant vessels, each of 8,600 tons, were launched. On the eve of the war this yard had a frontage of nearly a mile, and four building berths of from 400 feet to 600 feet in length, besides several for smaller craft. The company built its own steel foundry about ten years ago. Last year this concern launched 21 steamers of from 1,570 tons to 9,400 tons. It has just lately built a new plate mill.

Perhaps third in rank of capacity is the shipyard known as the Osaka Ironworks. This was founded by an Englishman, Mr. T. H. Hunter, in 1880, and was still owned by him less than ten years ago, and for anything the writer knows to the contrary Mr. Hunter is still living and controlling the yard. The concern comprises, besides the principal yard at Sakurajima, covering 16 acres, with a water frontage of 1,000 feet, and three dry docks, engine shops at Ajikawa Guchi, and repairing works at Temposen. Last year this company built 19 ships of from 1,212 tons to 7,789 tons.

Altogether there are over 200 shipbuilding and repairing yards in Japan, though most of them are limited to the construction of fishing and other small craft. About a dozen can build modern ocean-going ships. Besides the three companies just named, mention may be made of the Uraga Dockyard Company, which launched eight vessels of about 8,000 tons each last year; the new Ansano Company, seven ships of about 900 tons; the Yokohama and Fuginagata Companies, which launched several vessels up to 3,000 tons.

Of the four Imperial yards, the Kure and Yokosuka establishments have each accommodation for the construction of the largest battleships and cruisers, while the Sasebo and Maizuru yards are specially adapted for the building of smaller types of war vessels. These four yards, needless to say, are furnished with every appliance necessary for the rapid handling of materials. At Kure is the Imperial Arsenal, with its armour plate and big-gun shops, as well as the shipbuilding yard. At Sasebo there are three huge dry docks.

Preparations for Securing Trade After the War

A notable development in the Japanese shipping and shipbuilding trades is a movement towards a community of interests for securing trade after the war as well as for obtaining supplies of material during the war. Several of the purely shipbuilding concerns are combining in order that the various yards can be put exclusively on the classes of work for which they are most economically adapted, and combines are being formed among colliery owners, iron mining concerns, steel works and shipbuilding firms, with a view to bringing all phases of production under single managements. The methods of the German cartels in the co-operative buying of raw materials and disposing of finished goods are also being carefully considered. But primarily the difficulty is that of securing supplies of shipbuilding materials, and for this purpose such leading firms as the Mitsu Bishi, the Kawasaki, the Asano, the Uraga and the Yokohama dockyard companies have formed an association called the Sempaku Kyokai.

The Secretary of the Swedish Legation at Tokio reports that with a view to the further encouragement of the shipbuilding industry it has been decided to establish

a loan bank in Japan for advancing money on the security of ships under construction, on lines similiar to the Ship Mortgage Bank of Hamburg. The nominal capital is to be slightly over 2,000,000*l.*, but the concern will be able to enter into engagements up to ten times this amount, and efforts are being made to obtain Government assistance, or a guarantee.

Regarding the possibilities of Japanese competition with ourselves generally, it may be observed, first that current extensions of manufacturing and shipbuilding capacity, and of additions to our Eastern ally's mercantile fleet, are being made under abnormal conditions, at enormous cost for materials, which means most extravagant capitalization, and that the enterprises involved will thus find themselves heavily burdened with capital charges when prices and freights become anything like normal again, whereas our capitalization will be little or no more per ton of either manufacturing or shipping capacity, than it was before the war; and, secondly, that through shortage of plant, machinery, and skilled labor, it will be many years, even under the most extraordinary circumstances, before Japan can offer us any really serious competition.

Model Experiments on Express Cruisers of Deadrise Type

For High Speed Length Ratio Deadrise Type Proves Superior to Round Bilge Model—Resistance of Appendages Investigated

BY T. A. GAMON

EARLY in 1917 the speed and power question came up with reference to 72-foot express cruisers. We were in the position of having to face a trial with a displacement length coefficient unusually high for the speed length required. To arrive at a solution of the resistance speed question, several models of the deadrise type were tested for us by Professors H. C. Sadler and E. M. Bragg, at the University of Michigan model tank. Through the courtesy of Captain A. P. Lundin, president of the Welin Marine Equipment Company, the following results of these tests are published.

As the time available did not permit an extended series of tests, five models were used, elemental in form, having certain charactertistics assumed as favorable for resistance at high speed length ratios, and other characteristics, the effects of which were uncertain. It was hoped that careful analysis of these results would form a basis for a final set of lines suitable for the conditions laid down.

The following table gives the various dimensions and characteristics for the models.

The lines for model No. 5, are lines of model No. 1, contracted 27 percent in draft and expanded 27 percent in beam.

Fig. 4 shows the curves of total resistance and estimated frictional resistance, for the five models, all at 4.29 pounds displacement fresh water at E. K. and bare hull condition. As regards the estimated frictional resistances, the following may be said: Estimating frictional resistances by the usual method with the formulæ $R_f = fAV^n$, f, A and n are assumed as constant for a particular model at all speeds. Within the usual speed length ratios this is practically true, and for models Nos. 1, 3, 5 and 6, where, within the speed runs, in no case did the fore foot come out in water, this method was used. The values of f^n, and A used, being .01123, 1.94, and the areas of wetted surface to normal L. W. L., respectively.

Referring to Fig. 3, in which the wave profiles for model No. 2 are given at various speed length ratios $\frac{V}{\sqrt{L}}$, it will be seen that at high speed length ratios the fore foot came out of water. The wetted surface and mean immersed length did materially reduce at high speeds. So in this case the values of f, A and n should vary with the speed V. The curve of estimated frictional resistance for model No. 5 was estimated by a suitable adjustment of f, A and n with speed.

TABLE I.—DIMENSIONS AND CHARACTERISTICS OF MODELS

Model No.	Length L. W. L. in Ft.	Beam L. W. L. in Ft.	Draft to L. W. L. in Ft.	Corresponding Disp. F. W. in Lbs.	Max. Sect. Area in Sq. Ft.	Location of Max. Area.	Wetted Surface to L. W. L. in Sq. Ft.	C of B Aft $\frac{L}{2}$ in Ft.	$\frac{B}{H}$	$\frac{L}{B}$
1	3	.4475	.1387	4.29	.0368	$\frac{L}{2}$ 11% Aft	1.41	.0285	3.23	6.70
2	3	.4375	.1180	4.29	.0389	$\frac{L}{2}$	1.365	.238	3.71	6.86
3	3	.4125	.1440	4.29	.0343	$\frac{L}{2}$	1.355	.054	2.86	7.27
5	3	.5680	.1092	4.29	.0368	$\frac{L}{2}$	1.575	.028	5.20	5.27
6	3	.4475	.1440	4.29	.0347	$\frac{L}{2}$	1.485	0	3.11	6.70

The transoms are all square and dead flat on the bottom.

The sections are all practically right line except for model No. 6, which are concave below the chine.

All chine lines in profile make about 3 degrees with the normal L. W. L. forward except for model No. 2, which makes an angle of about 5 degrees.

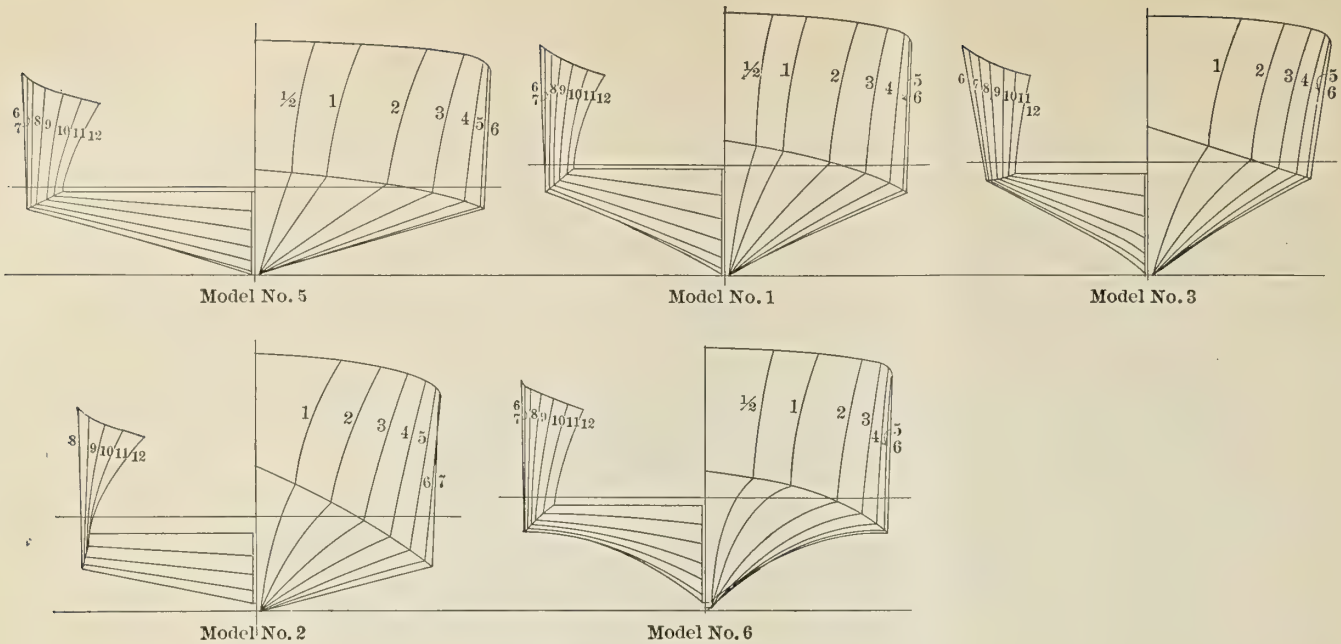


Fig. 1.—Body Plans

RESISTANCE CURVES IN FIG. 4

Referring to the body plans on Fig. 1, the sectional area curves on Fig. 2, and the table of dimensions, it will be seen that models Nos. 1, 3 and 5 are practically the same except for values of $\frac{B}{H}$. The curves on Fig. 4 indicate that up to a speed length ratio of about 3.8, both frictional and residuary resistance increase with $\frac{B}{H}$. Above a speed length ratio 3.8 the indication is that the residuary resistance and total resistance does not increase but rather decreases with $\frac{B}{H}$. Below a speed length ratio of 3.4 at any particular speed, the ratio of frictional resistance to total resistance is practically constant for the three values of $\frac{B}{H}$, and increases from .45 at $\frac{V}{\sqrt{L}} = 1.6$ to .7 at $\frac{V}{\sqrt{L}} = 3.4$.

Model No. 6 is very similar to model No. 3 except that the $\frac{B}{H}$ for model No. 6 is slightly greater and has concave sections. Referring to the curves on Fig. 4, it is evident that allowing for the slightly greater $\frac{B}{H}$, model No. 6 is still inferior to model No. 3; and though one model hardly justifies a conclusion, it seems that concave

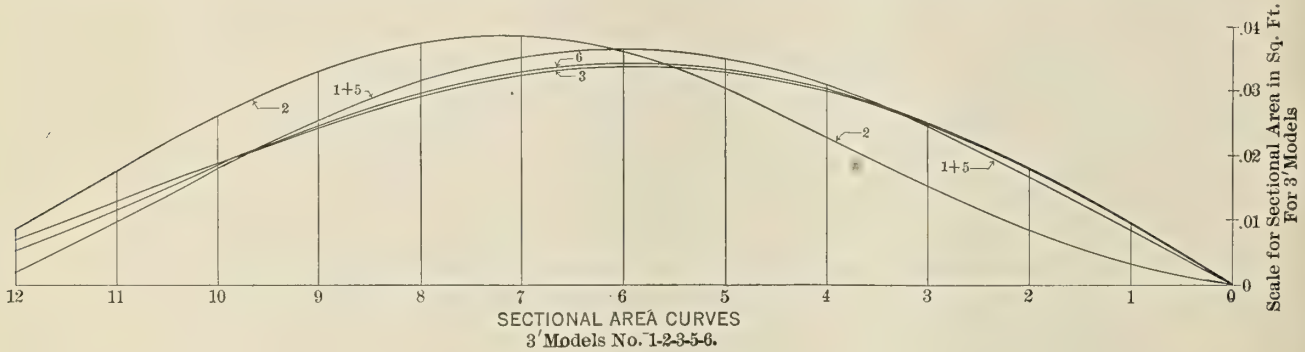


Fig. 2

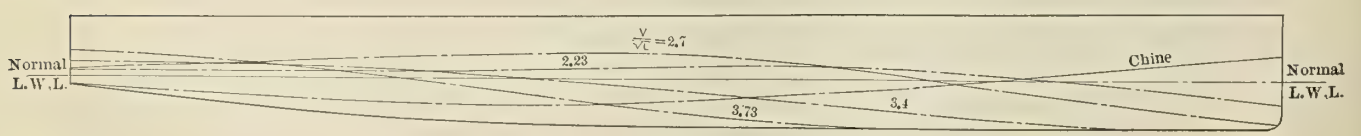


Fig. 3

Figs. 2 and 3.—Sectional Area Curves and Wave Profiles

sections are not beneficial for reducing the resistance.

The curves of total resistance (see Fig. 4) for models No. 2 and 5 agree quite closely in general character and

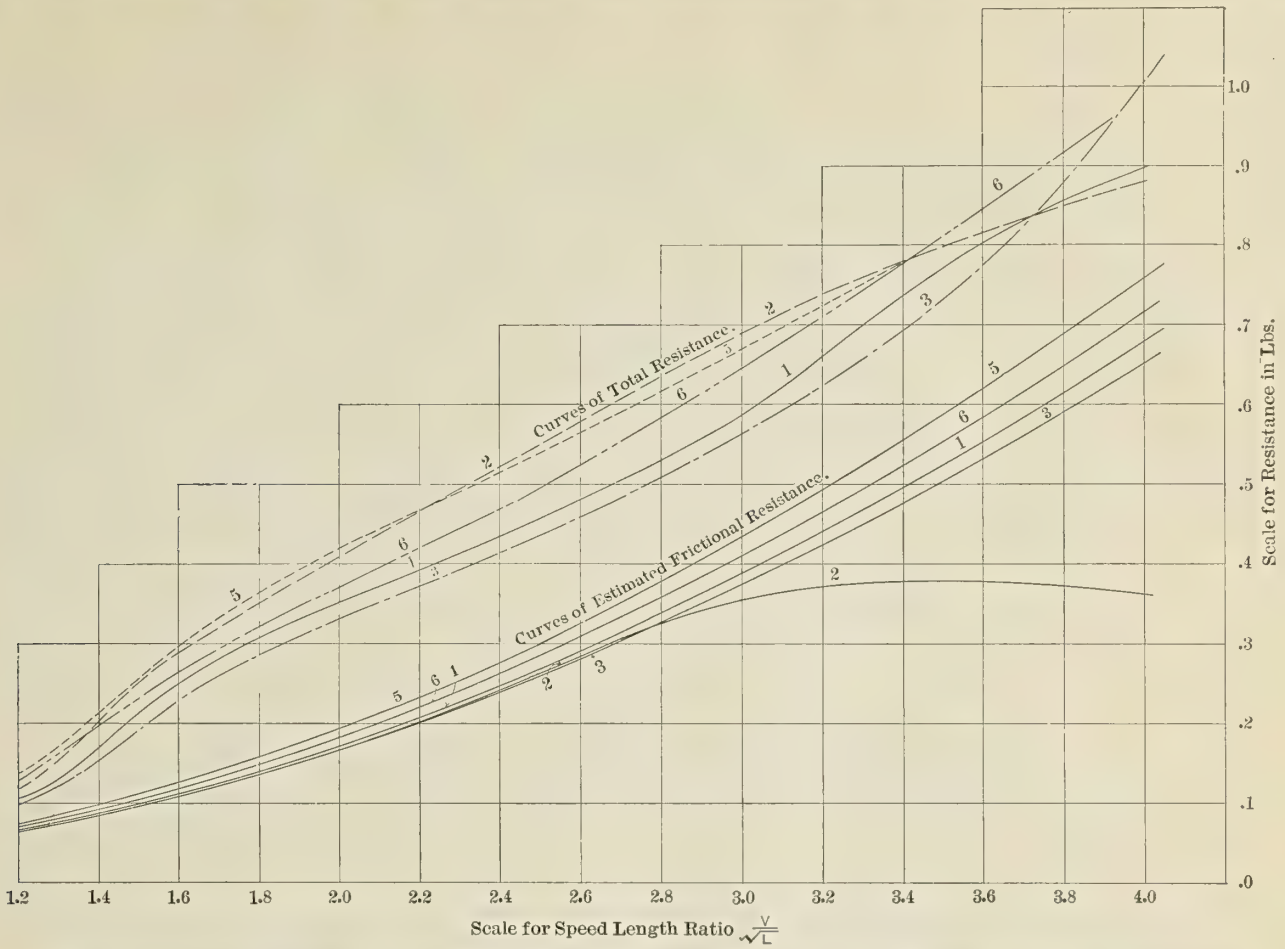


Fig. 4.—Curves of Resistance for 3-Foot Models Nos. 1-2-3-5-6, All Bare Hull at 4.29 Pounds Fresh Water Displacement

in value in spite of the fact that model No. 5 has greater $\frac{B}{H}$ and wetted surface than model No. 2. Apparently the very fine sectional area curves forward associated with greater angle of chine with L. W. L. are detrimental to speed. At extreme speeds with the wetted surface and mean immersed length decreasing, due to abnormal trim, the ratio of friction to total resistance is falling off so rapidly that when estimating the effective horsepower for full sized hull the inferior resistance qualities of model No. 2 are very apparent.

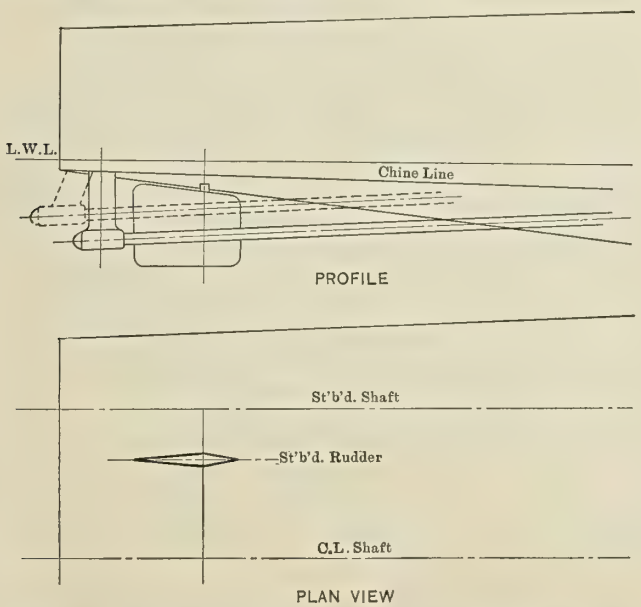


Fig. 5.—Appendages as Fitted to Model No. 1. Full Lines Indicate Arrangement No. 1; Dotted Lines, Arrangement No. 2. Rudders, in Size and Location, Same in Both Arrangements.

Appendage Resistance

Fig. 5 shows two arrangements of appendages as fitted to model No. 1, and Fig. 6 shows the curves of total resistance for the model run in all cases at 4.29 pounds displacement fresh water. Both arrangements are for three shafts and struts and two rudders. In both cases the rudders are the same in size and location, but arrangement No. 1 gives submerged propeller tips, whereas arrangement No. 2 gives the propeller tips emerged. The resistance curve for arrangement No. 1 shows a greater increase over arrangement No. 2 than was expected after allowing for increased length of struts and shafts, but it is reasonable to suppose that the decreased propeller efficiency for arrangement No. 2 would offset this increase in resistance. Arrangement No. 1 gives an increase in total resistance over that for bare hull condition of from 19 to 25 percent, and arrangement No. 2 from 6 to 12 percent. As is well known, model experiments exaggerate appendage resistance, and it is reasonable to assume that the appendage resistance would amount to from 15 to 17 percent of the total bare hull resistance.

Fig. 7 shows in full lines the resistance curves for model No. 5 run at bare hull condition and four displacements, as indicated, and in dashed lines estimated resistance curves for a round bilge type having the same length,

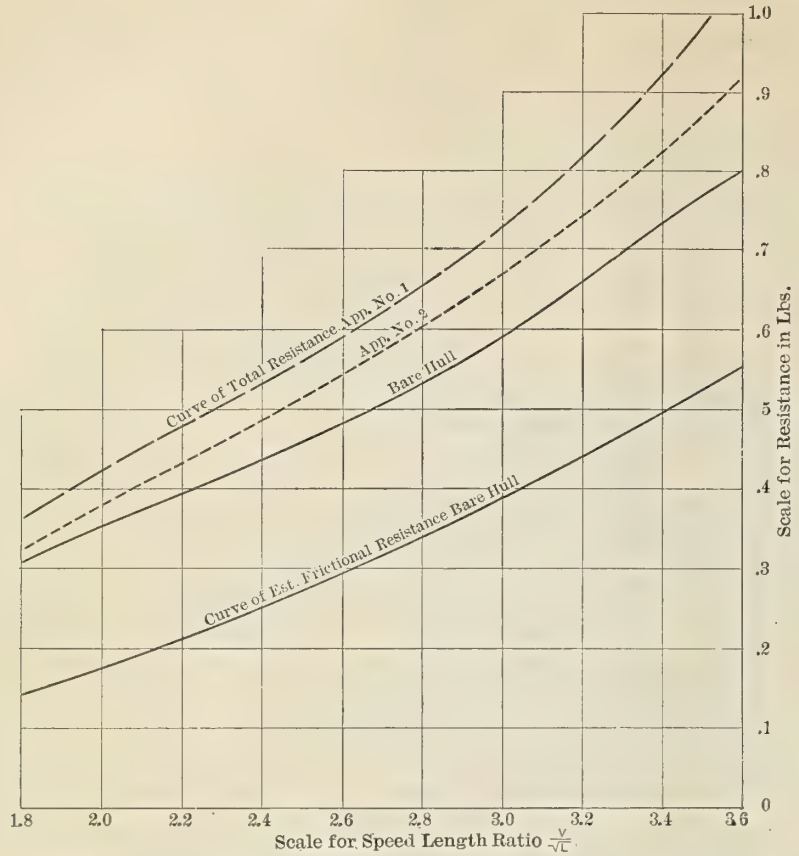

Curve of Total Resistance App. No. 1
App. No. 2
Bare Hull
Curve of Est. Frictional Resistance Bare Hull
Scale for Resistance in Lbs.
Scale for Speed Length Ratio $\frac{V}{\sqrt{L}}$

Fig. 6.—Curves of Resistance for 3-Foot Model No. 1, Bare Hull, with Appendages No. 1 and No. 2 as Shown in Fig. 5, All at 4.29 Pounds Fresh Water Displacement.

beam, draft and displacements as for model No. 5. The curves indicate that at any particular speed length ratio the resistance increases almost directly with the displacement, and the rate of increase is nearly the same for both types. The range of displacement length coefficient, $\frac{\Delta}{\left(\frac{L}{100}\right)^3}$, is only 69 to 87, and at lower values it may be found that in the deadrise type the resistance increases at a much greater rate with displacement. Of more importance, however, is the fact that there is a region in speed length ratio within which the deadrise type is superior from a resistance standpoint and a region within which the round bilge type is superior. The general speed service at which the hull is to be placed will determine the most advisable type to use. In case the hull is to be generally run at relatively low speed length ratios, the round bilge type is undoubtedly superior. Where the service requires a continuous high speed length ratio the deadrise type is superior. The feasibility of powering the hull to land within the beneficial speed length ratios must be considered.

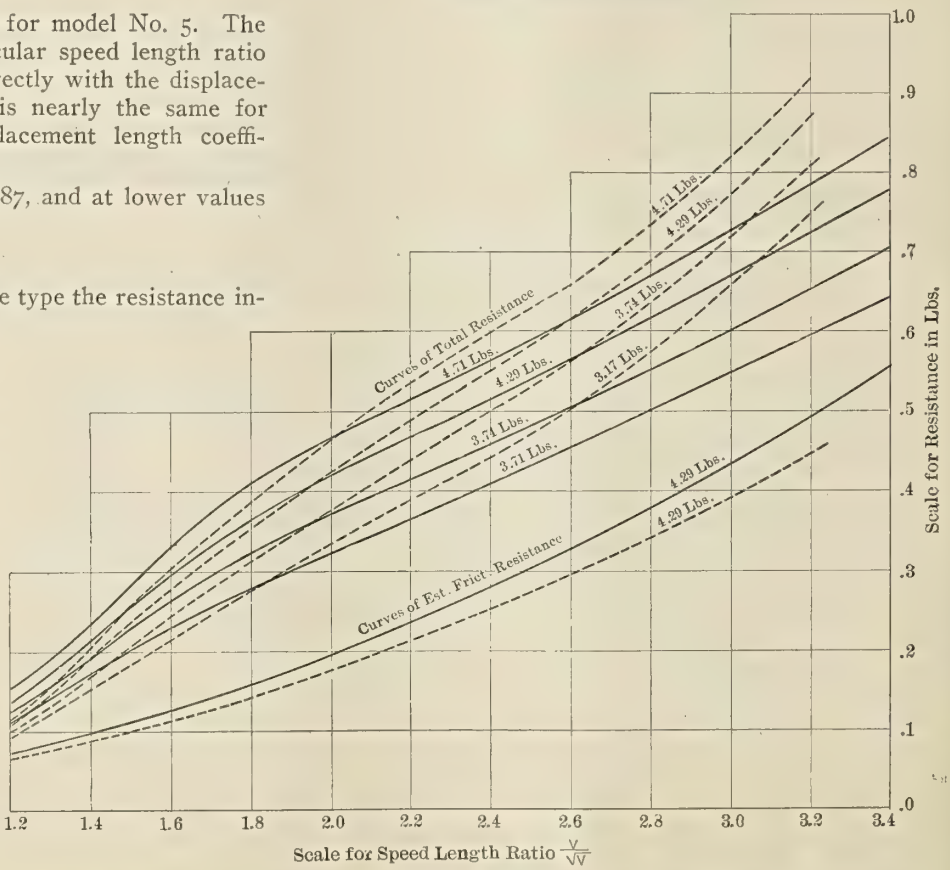


Fig. 7.—Curves of Resistance for 3-Foot Model No. 5 at Fresh Water Displacements Indicated for Bare Hull and Estimated Curves of Resistance for Round Bilge Type Having Same Length, Beam, Draft, Displacement and for Bare Hull. The Full Lines Are Curves for Model No. 5 and the Dash Lines the Estimated Curves of Resistance.

Engineering Section of Emergency Fleet Corporation

The Technical Department of the Emergency Fleet Corporation will be known hereafter as the Engineering Section of the Steel Ship Construction Division. H. C. Sadler, formerly professor of naval architecture at the University of Michigan, is naval architect and consulting engineer in charge of the Section.

Duties of New Section

The duties of the Engineering Section will be preparing designs, plans and specifications for ships, examining and commenting upon contractors' plans and specifications submitted for proposed contracts, examining and approving for delivery the final contract, plans and specifications, examining and approving contractors' plans submitted for approval of the Home Office, preparing specifications and plans for articles purchased direct by the Fleet Corporation, and examining and reporting on technical matters referred for such purposes by the manager of the Division.

Brill Heads Requirements Section

George M. Brill has been appointed head of the Requirements Section of the corporation, and J. H. Kirby has been appointed lumber administrator.

Electric Propulsion of Ships*

Results Obtained With Electric Drive on the Jupiter—Installations for Battleships and Cruisers

BY ESKIL BERG†

UNTIL within the last few years, reciprocating engines were used exclusively for the propulsion of boats, but with the advent of the steam turbine and its almost universal use on shore, where, due to its high steam economy, small size, and light weight, it has practically superseded the reciprocating engine, the practicability of its use for the propulsion of ships began to be considered. Some of the reasons why the turbine is preferable to the reciprocating engine as a prime mover are as follows:

First: Because it gives simple rotation and admits the possibility of a large range of expansion. At present the best steam engines of the triple- and quadruple-expansion type cannot, on account of the size of the low-pressure cylinder, be made with an expansion ratio of more than 16 to 1 or 20 to 1. In the turbines, however, there are practically unlimited possibilities of expansion, depending almost entirely upon the temperature of the condensing water. A vacuum of 29 inches is not at all an unusual occurrence, and 29.5 inches is being recorded in some of the larger central stations during the winter months. What this means may be better understood when we consider the available energy of a pound of steam when it is expanded from boiler pressure to various degrees of vacuum.

200 pounds pressure to 24 inches vacuum.....	220,000 foot-pounds
200 pounds pressure to 26 inches vacuum.....	238,000 foot-pounds
200 pounds pressure to 28 inches vacuum.....	265,000 foot-pounds
200 pounds pressure to 29 inches vacuum.....	289,000 foot-pounds

In other words, a turbine can realize about 25 percent more of the energy of the steam than the reciprocating engine, which means a saving of 25 percent in fuel, size of boilers, etc.

The small size of the turbines is, of course, another very important item. Incidentally there are a great many minor advantages, such as saving of oil, attendance, ash handling facilities, etc.

When the turbine is considered for ship propulsion there are a few facts that must be borne in mind, namely:

High speed turbines are lighter, cheaper, simpler, and more economical than the slow speed turbine. Propellers, on the other hand, are, within well-known limits, confined to slow speeds for high efficiency. Turbines, therefore, when used for direct connection to the propeller shaft, must necessarily be designed to operate at a speed which is too low for the economical use of steam, and even then cannot be conveniently designed for a speed low enough to secure efficient propeller action.

It is therefore necessary, in order to obtain the advantages of the high speed turbine and at the same time to be able to use a low speed efficient propeller, to have some form of reduction gear between the propeller and the prime mover. This condition is what led up to the application of electricity to the propulsion of ships, to the mechanical reduction gear, and also to speed reduction by means of hydraulic transmission. Electric propulsion is best suited to very large, high-powered vessels, especially in cases where good economy is desired at two or more speeds, as in the case of warships. The reasons for this are as follows:

Electric Propulsion Best Suited to Large High-Powered Vessels

Electric transmission affords a very simple and practical means of speed reduction in almost any ratio which may be desired.

It affords a very simple means of reversal by a change of electrical connections without mechanical devices, complication of piping, valves, etc. Any desired reversing torque can be obtained without affecting the efficiency of the equipment in the forward direction.

In the case of battleships, the feature that is particularly important is that electric transmission affords means by which the ratio of speed reduction is changeable by simple electrical connections, thus making possible the economical use of the same apparatus, both under high-speed and cruising conditions.

Electric transmission makes it possible to use a plurality of cruising and generating units, so that damage to one or more parts will not disable the vessel.

With electric transmission, high steam pressure and superheat can safely be used, and the gain in fuel economy by its use is best shown by these curves. A steam temperature of 700 degrees is now successfully used in Europe, which with 500 pounds steam pressure would give a superheat of 233 degrees. Heat available for work would then be about 36.3 percent, whereas under ordinary steam conditions, say 200 pounds pressure and 50 degrees superheat, we have only 30.75 percent available, a net gain of 18 percent in fuel, which would more than compensate for any additional weight or cost of the electrical equipment.

Turbo-generators are now built with an efficiency of over 80 percent, which with motors of 95 percent efficiency and a boiler efficiency of 80 percent would produce a shaft horsepower-hour with 0.825 pound of coal (containing 14,000 British thermal units per pound) or 0.61 pound of oil (19,000 British thermal units per pound), the latter figure comparing favorably with Diesel engines when lubricating oil is taken into consideration.

The first electrically propelled boats in this country (outside of electric launches) were two fireboats in the city of Chicago, the *Joseph Medill* and the *Graeme Stewart*, which were equipped with electric propelling machinery in 1908. The second example of electric propulsion is the large United States collier *Jupiter*. Due to the wonderfully fine performance of this collier, which has now been in service for about four years, the Navy Department decided to install electric propelling machinery in the battleship *New Mexico*, which is now nearly completed at the New York Navy Yard, and the apparatus for which has recently passed all government tests at the Schenectady Works of the General Electric Company. The Navy Department has also decided to install electric propelling machinery in six other new battleships requiring about 33,000 horsepower each, and in five large battle cruisers requiring about 180,000 horsepower each.

The *Jupiter* is a sister ship of the *Cyclops* and the

* From a paper on "Propulsion of Ships," presented at a joint meeting of the Electrical Section of the Institute and the Philadelphia Section, American Institute of Electrical Engineers, October 11, 1917.

† General Electric Company, Schenectady, N. Y.

Neptune. They each have 20,000 tons displacement and a carrying capacity of about 12,000 tons of cargo. The principal dimensions are: Length, 548 feet; breadth, 65 feet; depth, 39¼ feet; draft, 27 feet 6 inches. The *Cyclops* is equipped with reciprocating engines and the *Neptune* with Parsons geared turbines (built by the Westinghouse Company).

In giving the General Electric Company the contract for the *Jupiter* equipment, a water rate of 13 pounds per shaft horsepower at 14 knots and 15 pounds per shaft horsepower at 10 knots was guaranteed. During her official trials the *Jupiter* maintained an average speed of 15 knots for 48 hours, with 7,152 horsepower delivered to the propeller shafts and a propeller speed of 116.72 revolutions per minute. The water rate as actually measured was 11.68 pounds per shaft horsepower-hour. Due to the fact that the steam pipe between the boiler and turbine was too small, the steam pressure at the turbine was only 168 pounds instead of 190 pounds, for which the machine was designed. Since the official trials took place a larger steam pipe has been installed and the water rate reduced to 11 pounds.

Performance of the Jupiter

During her 10-knot run the water rate was 12.31 pounds. It will be seen from this that the guaranteed water rates of 13 and 15 pounds were beaten by about 20 percent. The *Jupiter* is to-day, according to the government records, making a speed of 12 knots with a coal consumption of only 55 tons a day, which is a record about 35 percent better than any boat of her size afloat to-day. The *Cyclops* on her trials developed 14.6 knots with about 6,000 horsepower and a steam consumption of about 14 pounds, or about 25 percent greater than the *Jupiter.*

The *Neptune,* equipped with Parsons geared turbines, has just recently had her trials and the published results give us the following comparison with the *Jupiter* and *Cyclops*

	U. S. Naval Colliers		
	Cyclops	*Neptune*	*Jupiter*
Weight of propelling machinery only, tons...	280	150	156
Steam consumption at maximum speed, pounds per shaft horsepower-hour.....	14.0	13.4	11.1

The third instance of electric propulsion is the new U. S. battleship *New Mexico,* which is now under construction at the New York Navy Yard. This installation provides conditions where the advantages of electric propulsion can be realized. The *New Mexico* is the largest and most powerful battleship which has been laid down by our navy up to the present time. She will have a displacement of 32,000 tons and a designed speed of 21 knots, requiring about 28,000 horsepower. The propelling machinery is, however, designed to deliver a maximum of 37,000 horsepower, and it is believed that this will give her a speed of 22 knots.

Electric Drive on the New Mexico

The equipment will consist of two turbo-generating units, four propelling motors (one for each shaft), switching apparatus, cables, instruments, etc. The contract also calls for two 300-kilowatt non-condensing, direct current turbo-generators, which will furnish excitation and power to drive the auxiliary machinery. As the General Electric Company was required to guarantee the steam consumption of the propelling machinery, including the auxiliaries, the greatest care was taken in their selection, and they are all to be electrically driven. The exhaust steam from the direct current generating sets which operate non-condensing will be used for heating the feed water, and any that may not be required for this purpose will be exhausted into the main turbine. The generators for the *New Mexico* are bi-polar alternators, and the motors are arranged to be connected for either 24 or 36 poles. For economic cruising at a speed of 15 knots or less, only one generating unit will be required with the motors on the 36-pole connection. For higher speeds the 24-pole motor connection will be used with both generators. One generator, however, will be capable of driving the boat up to a speed of about 19 knots.

Speed variations with either motor connection will be obtained by varying the generator speed, and a governor will be installed similar to that used with the *Jupiter* equipment.

The steam consumption guarantees as made to the government cover the total amount of steam used both by the main generating units and the auxiliaries, and are as follows:

Steam Pressure 250 Pounds Gage at Throttle

10 knots.....	14.6	pounds per shaft horsepower-hour
15 knots.....	11.4	pounds per shaft horsepower-hour
19 knots.....	11.1	pounds per shaft horsepower-hour
Max. speed.....	11.9	pounds per shaft horsepower-hour

Very heavy penalties are attached to these guarantees in case they are not met, namely, $25,000 (£5,140) per pound for the two lower speeds and $20,000 (£4,100) per pound for the two higher speeds.

At full speed the *New Mexico's* propellers will operate at 175 revolutions per minute, the lowest speed permissible within the space allowed. The propeller speed for the sister ship of the *New Mexico* with Parsons type turbines is 240 revolutions per minute, which, according to Captain Dyson, would indicate a propeller efficiency 9 percent worse than is expected on the *New Mexico,* and this difference would more than compensate for the electrical losses in the motors and generators.

In order to be able to correctly judge the relative economy of different methods of propulsion, it may be interesting to compare the water rate per effective horsepower, taking for examples of such different methods the battleships *Florida* and *Utah,* which are equipped with Parsons turbines; the *Delaware,* which has reciprocating engines, and the *New Mexico,* with electric drive.

	Propeller Speed	Water rate per effective horsepower per hour. 12 knots	19 knots	21 knots
Florida	328	31.8	24.0	23.0
Utah	323	28.7	20.3	21.0
Delaware	122	22.0	18.7	21.0
New Mexico	175	17.3	15.0	16.4

The guaranteed weight of the propelling machinery for the *New Mexico* without the auxiliaries is 530 tons, with a penalty of $500 (£102.5) per ton for any excess over this amount. The estimated weight of the Parsons turbine equipment for this vessel was 653 tons.

The contract price for the *New Mexico* machinery was $431,000 (£88,500), and the Navy Yard estimates show that a saving of $200,000 (£41,000) will be effected by using this equipment instead of the Parsons equipment as originally contemplated.

Electric Propulsion for Large Battle Cruisers

These vessels are designed to have a speed of 35 knots, at which speed they will require about 180,000 horsepower. There are four propellers operating at 250 revolutions per minute at maximum speed.

The installation proposed for these ships consists of four high speed turbo-generators, each having a capacity of about 35,000 kilowatts. On each propeller shaft there will be two independent induction motors, each having a capacity of 22,500 horsepower. The switchboard will be provided with an arrangement by which any combination of generating units and motors can be used, and starting, stopping, and reversing can be instantly done by movement of a lever. All changes of connections are made

on dead circuits, so that there can never be any big rushes of current to strain the apparatus. Safety devices are also provided so that any unbalancing of current will open the circuit of that particular unit in which it occurs.

The total weight of the complete equipment for one of these vessels is about 1,800 tons, of which the turbines alone weigh about 350 tons.

Ljungstrom System of Electric Drive

That electric propulsion can also be profitably applied to a small boat is proved by Mr. Ljungstrom, in Sweden, in the case of the small coastwise steamer *Mjolner,* which is only 225 feet long, 56 feet beam, and 15 feet draft, requiring 900 horsepower. Stockholm's Rederiaktiebolajet Svea decided to build two sister ships, the *Mimer* and the *Mjolner.* The *Mimer* was equipped with triple expansion engines, and Mr. Ljungstrom guaranteed a saving of 30 percent in fuel with his method of electric propulsion in the *Mjolner* over the *Mimer* equipped with engines. The boats have now been built and tested, and the electrically propelled boat showed a saving of 42.3 percent in fuel consumption. This is indeed a remarkable record, but may be partly explained by the increased efficiency of the boiler plant. For his electric drive Ljungstrom uses 218 pounds steam pressure and 235 degrees superheat, and this alone would effect a saving in coal over the *Mimer* of about 15 percent.

In this boat Ljungstrom uses two 400-kilowatt turbines running at 7,200 revolutions per minute, generating 3-phase, 120-cycle current at 500 volts. This current is used to drive two induction motors which are geared to the main propeller shaft. The motors run at 900 revolutions per minute and the propeller shaft at 90 revolutions per minute. All of the auxiliaries are electrically driven, which affords another appreciable saving.

Mr. Ljungstrom has done some wonderfully fine engineering in connection with this equipment and has combined electric propulsion with mechanical gearing, which is a great step forward.

Marine Terminals for Inland River Cities Located on High Ground

Principles Governing Construction of Efficient River Terminals—Design and Equipment—Mechanical Co-ordination Between Water and Rail

BY H. MC L. HARDING*

MANY of the terminal cities and towns of the Mississippi River and its tributaries, also those of the Pacific and Gulf coasts, are situated on high ground far above the ordinary river levels. This is on account of the great and sudden rise of the rivers, varying from fifteen to sixty feet. These high-lands in the interior are generally called bluffs.

On account of this height and of the steepness of the banks, the transference of freight between the river and the city in the past has been difficult and has resulted in greatly reducing the volume of river transported freight. Unless there is a change in river terminal methods, the railway freight stations will be preferred by the shippers and consignees.

Deepest Water Near Bluffs

Cities are not often located on low lying ground on account of liability of overflow, but upon these bluffs. Near the foot of such bluffs, especially where there is low land on the other side of the river, there is generally the river-channel, where is the deepest water in the river, opposite the city.

From the various illustrations, it will be noticed that where their are steep banks the horizontal distance from the top edge of the bank to the natural or dredged channel is in most cases less than at seaports, so that the width of the river quay is even less, that is, the "built out" section. As barges or other inland river vessels are of small draft, berths with sufficient depth can be found near the shore.

Quays Preferable to Piers

Where possible, quays are preferable to piers in regard to the initial investment and the cost of maintenance. They are less liable to injury from ice or impact of vessels, and greater speed of discharging and loading is possible.

Drayage Difficulties

It is necessary for the load to be raised to the top of the bank in any event, whether by drays, man power or inclines. Free vertical freight movements are much quicker in operation than any other method. That the loads must finally reach a certain elevation should always receive consideration in the designing.

In some cases, in ancient days, wharves of different stories have been constructed, the idea being to unload at different levels at different heights of the river.

Peculiar Designs

Where this design is consented to, it is generally necessary to construct ramps or steep inclined roadways to these different levels which are flooded at certain seasons.

The levels and roadways are expensive to construct and to maintain, adding by the increased number of freight movements on the different floors to the operating costs. Rehandling methods are not advisable.

Why there is not one direct vertical lift from the barge itself to the upper level is difficult to understand. The height of the bank is no obstacle to speed, and the lifting height adds little indeed to the expense of operation.

The few quotations from the Government Report, House Document 226, 63rd Congress, pages 980-981, will make clear some of the difficulties of past terminal operation.

Grades and Condition of Roads to Terminals

Grades even on a paved road over six percent are difficult to surmount. The terminal approaches or roads are generally in wretched condition. The descriptions of grades refer to different inland river terminals.

* Consulting Engineer, New York. Terminal Engineer, Upper Mississippi River Improvement Association. Terminal Expert for the State of New York on Barge Canal Terminals.

Coal Tipple, the Forerunner of Permanent Type of Marine Quay, Built into River and Protected from Ice by Clusters of Piles

Loading Barges at Coal Tipple

Grade of road 20 percent, not paved, in ruts, muddy in rainy weather.

Grade 20 percent, very muddy if used in wet weather.

Grade 13.8 percent, very muddy, form ruts.

Grade 15.3 percent, not room at bottom to turn.

Grade 22 percent, muddy.

Grade 10.5 percent, poor condition.

Grade 18 percent, clay—very bad condition.

Grade 12.5 percent.

Grade 11.4 percent, poor roadbed, little better than a ditch.

Grades at other places, 17.7, 13.7, 12.3, 17.2, 16.8 percent.

These grades are horse-killing and gasoline (petrol) consuming.

The above are the reports of the Government engineers.

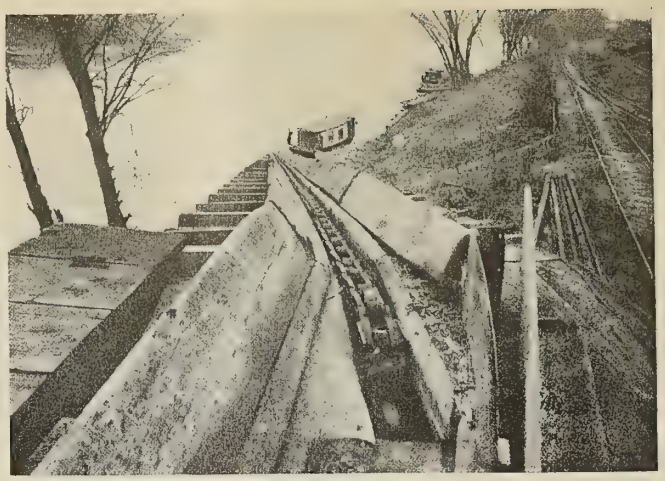
Low Water Most of the Year

During most of the year the river is at the low level and the inbound river freight must be carted up these poor roads. In larger cities where there are paved levels, the hauling of heavy loads up the levee grades is not easy and very expensive.

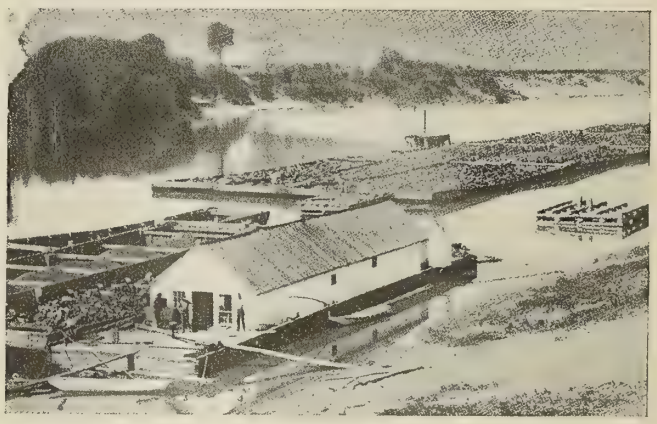
It is interesting to note that in many engineering reports too little attention is given to speed of transference, that is, the tonnage capacity per linear foot which depends upon the operating speed.

Speed of Transference Essential

There might be by some form of rope haulage and winches and a platform a fair means of surmounting the bank for a small tonnage of miscellaneous freight, chiefly limited, however, by the congestion at the top of the



Inclined Railway Tie Hoist Requiring Two or Three Handlings. With Jib Cranes Only One Handling Would be Required



Type of Existing River Terminal with Wharf Boat, Ice Pier and Road Approaches

incline or the necessity of having a large gang of men to bring the freight from various portions of the boat to the foot of the incline and away from the top of the incline for the assorting, distributing and tiering. With one incline there are many idle minutes.

Terminal Congestion

In case there are large and prosperous communities with the earnestly desired river-transported freight, there immediately arises great congestion, a small army of men being required with long detention of the barges. The increased unnecessary terminal expense is more than the saving in river transportation over rail.

The above kind of terminal designing is not advisable either from the standpoint of first cost or expense of operation.

Elevation of Banks No Obstacle

With a correctly designed quay equipped with such facilities as traveling gantry jib cranes of great speed transferring capacity and adapted to transfer and handle every kind of freight, the height of the bank is no obstacle to securing most satisfactory commercial results and the objection to high banks or to the rise of the river is eliminated.

Probably the average height of hoisting would not exceed thirty feet with a maximum of not above seventy feet.

The standard specifications for the unusual gantry jib crane at steamship terminals require a lift of 80 feet with a load of from two to five tons, at a hoisting speed of

200 feet per minute, and it will be seen that the average of lift at these river terminals is far below the customary height of lift at sea ports.

At 200 feet per minute hoisting speed, thirty feet more or less, requiring about ten seconds, is a negligible item in time or expense of transference. As the volume of freight increases, more cranes can be added up to the linear capacity of the quay.

Designs

The type of the substructure and its material will depend upon the volume of freight, the importance of the terminal and the appropriation available. To determine the exact design and kind of construction a careful engineering study on the ground is necessary.

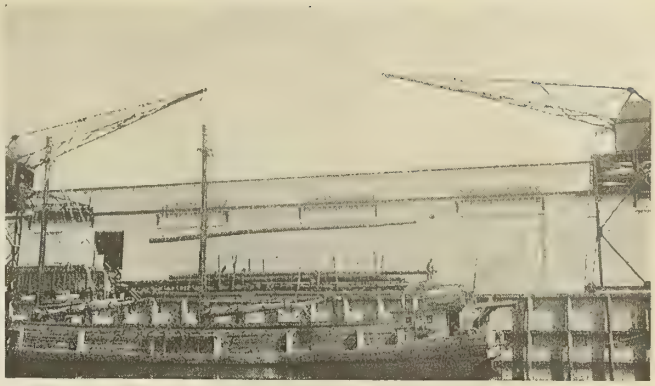
As explained later, the water frontage of a quay may be a unit 300 feet long and when properly equiped will have an annual transferring capacity of about 100,000 to 125,000 tons. In some cases, therefore, the quay frontage can be two hundred feet in length and possibly less.

The Terminal unit comprises the quay, the railway tracks in front of and behind the shed, the space—some thirty-five feet in width—between the shed and quay frontage, served by overhead traveling jib gantry cranes, the shed of sufficient height with internal loop cranes for assorting, distributing and tiering freight. There should be a warehouse forty to sixty feet to the rear of the shed controlled by the terminal authorities even when privately owned.

Where the tonnage of freight is small or mostly of one commodity, and especially when privately owned, various devices have been employed, some of which are herein illustrated, and which for the purpose intended are excellent.

Rear Face of Quay Wall Built Out Into River. Space to be Filled with Sand from River. Height of Wall 16 Feet

Space Behind Wall Nearly Filled. End of Wall Temporarily Closed by Bulkhead on Piles. Depth of River at Low Water 26 Feet



Modern River Terminal. Front of Quay Wall Protected by Fenders. Gantry Cranes Used for Transfer of Freight from Barges to Cars on Quay or Into Shed

Types of Machinery

If, however, there is to be established a public terminal where there are many different commodities of various sizes and descriptions to be transferred and where the speed transference and handling is the most important feature of the terminal, then it is evident that where there must be such machinery which, by a continual succession of movements, will rapidly and without manual rehandling take the freight from its exact place in the river barge and by mechanical co-ordination deposit it in its proper place at the elevation of the top of the bank. If for delivery within forty-eight or seventy-two hours, it is placed in the shed, or in the warehouse if for long storage, and from the shed into the warehouse after seventy-two hours. Similarly, freight should be stowed in the barge with no rehandling.

No Manual Rehandling

There should be no man-handling on the barges, that is, moving the freight from one place in the barge to another, or manual rehandling on the top-level from one point to another. This should be done mechanically.

Terminal Principles

Principle No. 1.—There should be possible free vertical movements of freight to and from its place in the barge. The level of the quay should be about the same as the top of the bank. Any covering of the barge should be constructed so as to be removable in order not to interfere with the vertical movements of the freight.

It is not sufficient merely to unload the barge upon a wharf boat, but it must be taken by the machinery to the upper level of the river bank. It is quicker, easier and less expensive to raise the load vertically to the required level by one movement and swing into the shed or on to the car than to unload upon a houseboat, platform or incline, and then by other means, as drays, man power, or inclines raise to the height required and then move again by manual labor.

The investment is reasonable, if the terminal be correctly designed and can be made proportional to the size and needs of each community.

Principle No. 2.—Freight should be lifted or lowered vertically to or from any part of the barge by such mechanism as will take from the boat and place within the shed or from the shed into the boat.

A far larger proportion of the freight than is usually expected is commerce or through freight, that is, freight

(*Concluded on page* 487.)

Letters from Marine Engineers

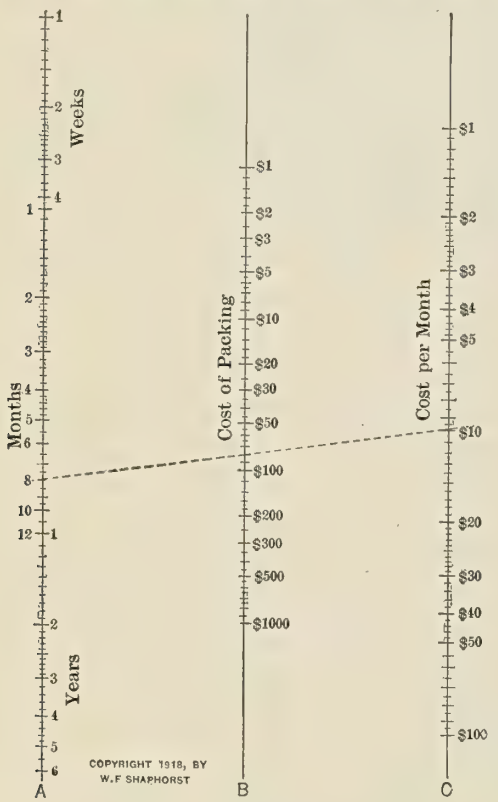
Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Chart for Comparing Costs *

This chart will be found handy for determining the cost per month of the various materials used in and about the engine room. It is a good thing to keep tab on supplies purchased so as to know when bought and when replaced. Then by dividing by the number of weeks, months, or years of service the cost per month is found and the engineer can decide whether or not to purchase the same thing again.

For example, let us assume that a certain engineer bought what he thought was a good grade of packing.



Cost Chart

He packed his pumps with it, and found the total cost to be $80. After eight months the packing was worn out and had to be replaced again. What was the cost per month? That is an easy one, and can be done mentally, but just to show how the chart works I have selected an easy one for a starter. The dotted line drawn across the chart shows that you merely lay a straightedge across connecting the $80 (column B) and the 8 (column A) and the extension of the line cuts column C at $10. In other words the packing costs $10 per month.

The engineer now sees a given packing advertised which, it is claimed, will last much longer, but its first cost is more. He might naturally say to himself without figuring at all, "That costs too much. I can't afford it. Guess I had better use the same old packing." However, the engineer leisurely lays a straightedge across the chart connecting the claimed length of life (two and one-half years) with the estimated cost ($200) and he finds to his surprise that such a packing would cost him a trifle over $6.50 per month. He rubs his eyes. He tries again. He thinks there must be something wrong with the chart, and "dopes it out" longhand, only to find that the chart, after all, is pretty accurate. As a result he purchases the packing which costs more at first but considerably less in the long run. It is evident, therefore, that the chart is a valuable one and it would be well to keep it in a handy place whenever looking through advertisements or whenever purchasing supplies.

The chart applies not alone to packing, but to anything that wears out in a short time. Gaskets, cylinder oil, belt treatment, belts, valves, grate bars, etc., all come under this head. Even though the exact cost may not be given in column B it is a simple matter to shift the decimal point in such a way that the correct answer will be obtained in column C. Thus, if you bought only three cents' worth of waste, and if it lasted four weeks, you would connect the four (column A) with the $3 (column B) and the line cut through the $3.50 in column C. It is evident that in writing three cents with a dollar sign in front of it, it becomes $.03. The decimal point is, therefore, shifted two places to the left in column B, and at the same time the decimal point must be shifted the same number of places to the left in column C, which gives us 3½ cents per month as the answer.

The range of the chart, it will be noted, is wide enough to care for every ordinary case of supply purchasing.

New York. W. F. Schaphorst.

* Copyright, 1918, by W. F. Schaphorst.

Cargo Record

A London newspaper, *The Daily Express* of June 27, 1918, gives publicity to the following:

"A new record has been established in the rapid discharge of cargo. A steamer laden with 6,200 tons of iron ore was discharged in 45½ hours, giving an average per crane of 40½ tons per hour. In one period of twenty-four hours no less than 3,366 tons was discharged."

It is more than probable that this is by no means a world's record. When the writer was trading to the Baltic port of Lulea, a very large vessel of Dutch nationality, specially built for the purpose, used regularly to ply between Rotterdam and Lulea. Her appearance resembled a bedstead more than a ship, for she had 12 double derrick masts and 24 winches; it may have been more. Her tonnage was very large and her rate of discharge must have been correspondingly high.

The preparations now being made at the new South American port for loading iron ore for the United States must, if report be true, be considerable. A recent account states that 16,000 tons can be loaded in a very few hours.

It is needless to add that discharge is always slower than loading, for at Lulea 10,000 tons could be loaded in 24 hours, a matter of fifteen years ago. Nor is there any need to labor the point that rapidity of terminal

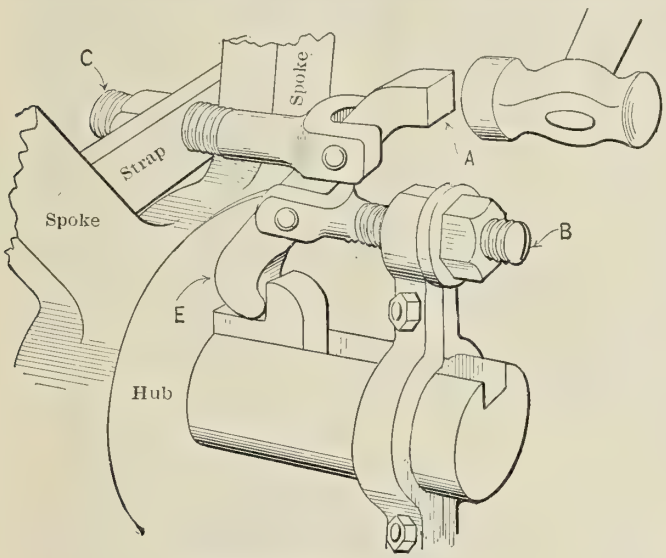
turn round is equivalent to a large addition to available tonnage. This was the first problem tackled over here when tonnage became restricted.

The absolute record for discharge as for loading must be oil, for the facility and ease with which it can be put in and taken out must place it first on the list.

However, rivalry in the matter of discharging is of considerable interest at the moment, hence these remarks from London. A. L. Haas.

Key Extractor

While on a recent visit aboard an ocean liner I came across a rather strange sort of key extractor. The second engineer's crew was doing a bit of overhaul work on the ice machine, and at the time I arrived they were taking off the large fly-wheel. My attention was at once attracted to



Method of Extracting Key

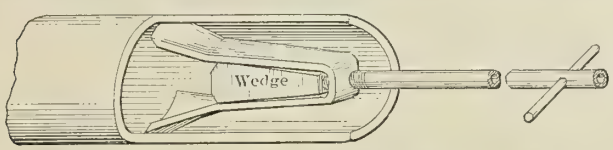
the device they were using to pull the key. A rough sketch of it is shown. The engineer in charge devised it and explained its merits. The sketch is self-explanatory. A hand hammer is used to hit jarring blows on *A* when the tension is taken up on the two bolts, *B* and *C*. After the key is started, distance pieces are used at *E*.

The hub of this fly-wheel set up flush to a shoulder, the key was therefore only accessible from the one end.

This device is passed on to show how some fellows contrived to rig up tools to get around stubborn jobs. It works excellently and seems worthy of describing to the readers of Marine Engineering. C. H. W.

Cow Mouth Scraper

The boys called this a cow mouth flue scraper; but be that as it may, its name is not important. This little tool is



Partial Section of Tube, Showing Action of Scraper

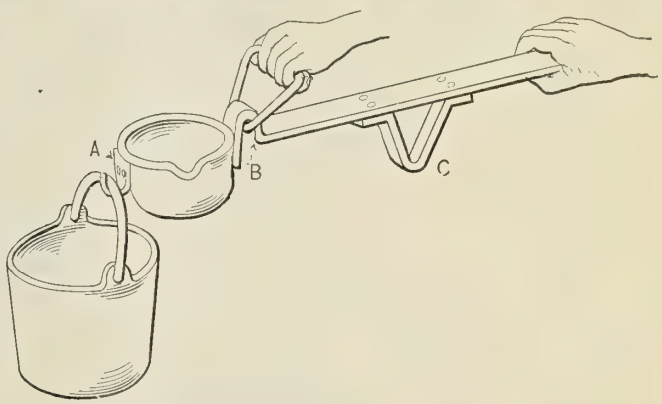
cheaply and quite easily made from a piece of pipe for the handle, a bit of bar stock for the wedge, and an old 14-inch flat file for the scraper.

The sketch tells the tale of how it is made but a few words may help to make it clearer. Cut the tang off the file, heat it cherry red and draw both ends of the file down wedge shape. Spread so as to give the bell shape by forming them over the horn of the anvil. Drift a hole through the center of the length of the file for the handle, then form it to the U shape, being guided by the diameter of the tube that you are making the scraper for. Next make a wedge and tap one end for a stud or screw. By means of this, the diameter of the front edge of the scraper is governed. Make and fit the piece of pipe for a handle and the tool is ready.

Fireman.

Handy Babbitting Ladle

The sketch shows how the ordinary babbitting ladle may be made a great deal handier for the work. By riveting a hook on as indicated at *A* and bending a part of the handle as shown at *B* to permit the use of a triangle made of wire for lifting the babbitt ladle when hooked on to the



Sketch of Ladle Showing Attachments

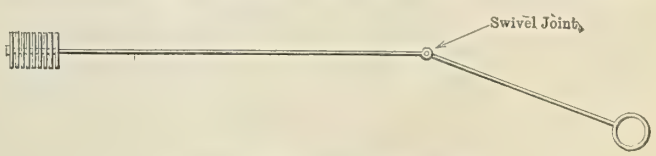
melting pot, as shown, and riveting a foot, as shown at *C*, to the handle, the alterations are complete.

When carrying any quantity of hot babbitt in a large ladle, the triangle used at *B* permits it to be done with greater ease. When the job of pouring is complete there is sometimes a small amount of babbitt left in the ladle, and if it is desired to set the ladle down, the foot *C* permits this being done without it tipping and spilling.

Machinist.

Adapting Flue Scaper Handle for Restricted Locations

The scraping out of boiler tubes in order to remove the accumulation of soot and fine ash dust is an essential op-



Jointed Flue Scraper Handle

eration in securing good boiler economy, but where the space is restricted and where it is impossible to use the long handle scraper usually employed, the matter is liable to be slighted or overlooked.

An exceedingly simple method of overcoming this obstacle is by means of a handle made as shown in the attached sketch, from which it will be noted that a swivel joint is made about half way down the handle so that the

scraper can be manipulated in the least amount of space, since as soon as one section of the handle is out of the tube it can be bent over, allowing room to pull the following sections out.

While the sketch shows but one joint, if the conditions are very restricted, two or more sections can be used.

Philadelphia, Pa. W. A. LAILER.

Two Electrical Kinks

Fig. 1 shows a fuse gripper made from part of an old boxwood rule. The sketch is self-explanatory. Two legs of the rule are all that is necessary. A groove for the round part of the fuse is cut as shown at *A*, and used as

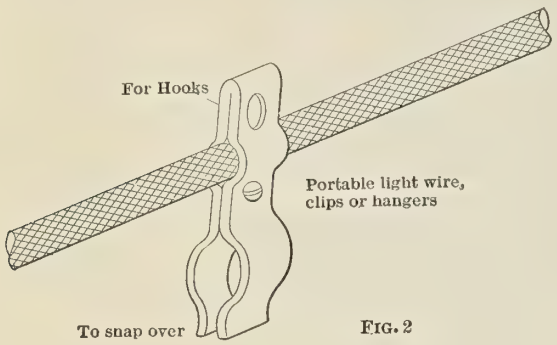


FIG. 2

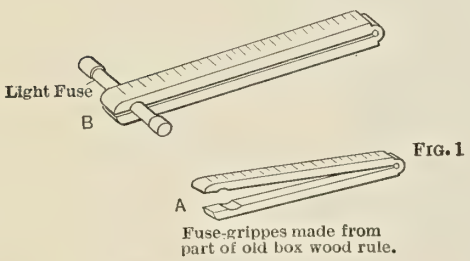


FIG. 1

Fuse Gripper and Hanger

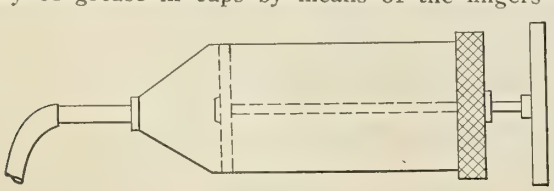
shown at *B*. This will be found very handy and save many a shock to the system.

Fig. 2 shows a very neat and useful brass clip or hanger for portable electric light wires. These are made from ⅛- and 1-inch flat brass stock, and permit the slack of the light wire to be hung up or snapped up by either side of the device. This contrivance will be found to save a great deal of trouble in the use of a portable light aboard ship.

ELECTRICIAN.

Convenient Method of Feeding Grease Cups

The customary method of feeding or replenishing the supply of grease in cups by means of the fingers or a



Grease Gun

putty knife or stick is at the best an unsatisfactory and inconvenient one, usually smears up the surrounding parts and also involves the loss of not a little grease. Where a grade of grease is used that is not too thick or gummy the work can be done more neatly and much quicker and with a saving in grease by making use of a grease gun, as shown roughly on the attached sketch.

The cylinder of the grease gun can be filled before starting on the round and then by merely pressing down the plunger a supply of grease can be inserted into each cup. Such a grease gun can be made of an old oil squirt gun or can be easily made of some brass tubing.

A gun about 2½ inches or 3 inches diameter will be found most satisfactory for general purposes, the length depending upon the quantity of grease used and the space limitations.

Philadelphia, Pa. W. A. LAILER.

Long Jaw Toggle Clamp

This is a rather odd type of clamp, but it is adaptable to many kinds of work aboard ship, and when one gets

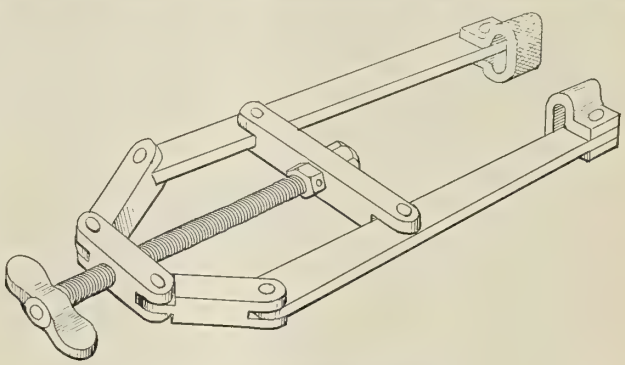


Fig. 1.—Toggle Clamp

spare time to make it from odd stock it is not very expensive. There are two of them in the shop kit of one of our repair vessels in the Navy, and the machinist's

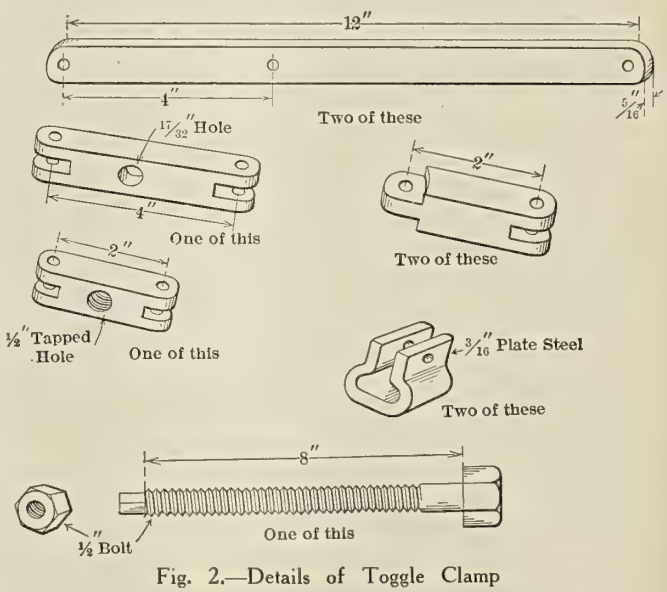


Fig. 2.—Details of Toggle Clamp

mate in charge, who made them, says that they have proven very useful.

All the dimensions are given in the detail drawing, as shown in Fig. 2. The whole thing should be made if possible from good stock. It will last longer and give better service.

Concord, N. H. CHAS. H. WILLEY.

Reach Rod Kinks

These are two ideas that are used by several ships in our navy for reach rods on valves that are up overhead out of reach. The ideas are common, but I have visited many ships where they have not worked such kinks in,

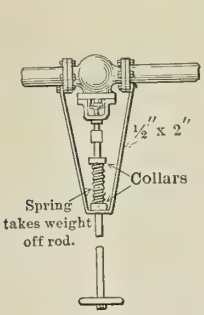


Fig. 1

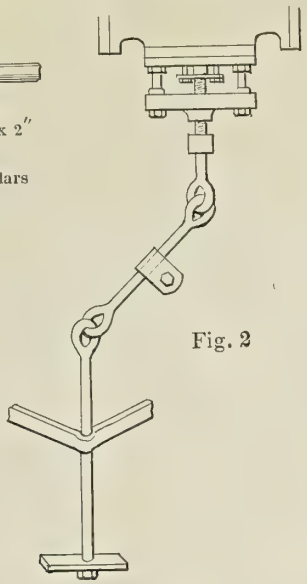


Fig. 2

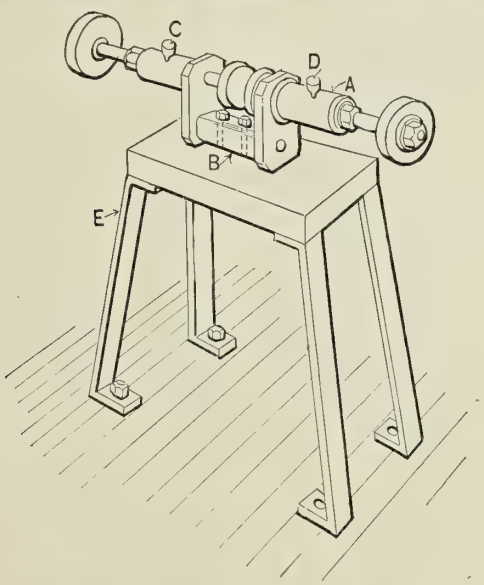
Universal Joint Reach Rod

and are content to climb up upon the pump or engine to reach a valve, or where they do employ reach rods the whole weight of the heavy rod hangs on the valve stem, wearing its threads at each operation.

Machinist Mate.

Buffing Wheel

While on a recent visit to a brother engineer's vessel he showed me a novel buffing and emery wheel constructed from a discarded blower engine crankshaft, one that had



Emery and Buffing Wheel Mounted on Old Crankshaft

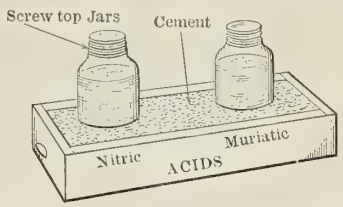
become badly scored and unfit for further use. The sketch shows how he had converted it from uselessness to a very handy machine.

Both the crank pin and shaft journals were hollow. Several anchor holes were drilled in the shaft journals; then the inside of the shaft *A* was poured full of babbitt. A shaft for the emery and buffing wheel with necessary collars, nuts, washers, and a pulley was made. The babbitt was bored for this spindle shaft, and the crank pin *B* was drilled for two securing bolts; oil cup holes *C* and *D* were drilled, and the stand *E* made. This completed the job and gave a unique and useful machine.

Chief Engineer.

Two Kinks

Both of these sketches talk for themselves, so little need be said except that they were picked up on visits to the other fellow's plant. It pays to exchange ideas and



Safety First Non-tipable

Safety First

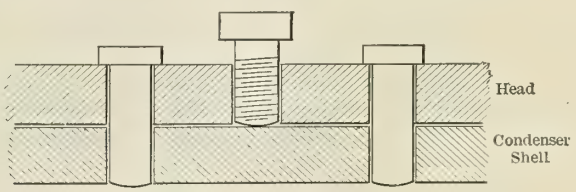
Safety First Kinks

experiences. A visit to a brother engineer's plant may put a few more ideas in your head and dollars in your pocket—at any rate, visiting in spare time pays.

W.

An Aid in Removing Condenser Heads

Very frequently after condensers have been in service for some time the gasket joint between the shell and heads becomes cemented together very tightly and frequently trouble is encountered in loosening the head after the bolts have been taken out. The usual practice of in-



Arrangement for Loosening Condenser Head

serting a chisel between the head and shell destroys the gasket and produces unnecessary strains on the apparatus.

A very simple arrangement for loosening the head is to tap into the headpiece—one on each side—a 1-inch tapped hole, threaded, to take a round ended bolt. After the head bolts have been loosened and taken out the most tenacious joint can usually be broken by inserting the one-inch bolts in each of the four tapped holes and drawing them up evenly turn by turn.

This represents a rational method of doing the job and makes it worth while because of the saving of the difficult gaskets used on the condenser heads.

Philadelphia, Pa. W. A. Lailer.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in this Department

CONDUCTED BY H. A. EVERETT

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

There will appear in this column from time to time questions which have been asked by the Board of Steamboat Inspectors in the various examinations for engineers' licenses conducted by them. Such questions will be denoted by an asterisk (*) placed before the number if from examination for grade of chief, and by a dagger (†) if from examination for other grades.

Formula for Babbitt Metal

Q. (979).—Can you give me a formula for a babbitt metal which does not use as much tin as the present tin base babbitt used in marine bearings. The acute shortage of tin makes it desirable to use as little of it as possible provided we can get a satisfactory bearing with less.

A. (979).—The following has been recently used in bearing of marine engines of piston speed not exceeding 700 feet per minute: lead, 79 percent; tin, 9 percent; antimony, 12 percent.

Development of Stern Plating Around the Cant Frames

Q. (984).—Kindly publish in your question and answer column the most modern and correct method of developing plates around stern cants?

A. (984).—The stern plating around the cant frames above the lower knuckle line is cylindrical in form, that is, the surface is generated by a cylinder whose axis remains parallel to the center line plane of the ship. By assigning this form the plating is developable and the true shape of the plates that go to make up the overhang can be determined.

Usually the form of the stern is fixed by the straight rake line *A S* (Fig. 1), the knuckle line and the rail line. The rail and knuckle line in the sheer and half breadth plan are faired by the buttocks *B*-1, *B*-2, *B*-3, *B*-7. It will be observed the buttock lines between the rail and the knuckle line in the sheer plan are straight and parallel to the rake line *A S*; this is because the surface is generated by a cylinder with axis parallel to the center line.

The stern frames are then transferred to the half breadth plan; these are usually straight lines. The stern may now be cut by a plane at right angles to the rake line. The trace of this plane in the sheer plan is a straight line *A B*. The true shape of the curve of intersection of this plane with the hull is obtained by swinging it down into the horizontal; this is shown by swinging arcs with *A* as a center and the intersection with each buttock as a radius. These points can then be projected into the half breadth plan on their respective buttock lines and the true shape of *A B* is obtained as indicated. Next revolve the rake line *A S* into a horizontal plan to the position *A S'* and imagine the line *A B* together with the whole of the stern plating revolved into the vertical. In the new position *A B* will appear as a straight line touching the paper only at the center line. Its true form is given by the line from *A'* to *B'* and it is possible to measure around it and take its girth with a flexible batten, spotting off the various buttock lines. The batten is then laid off straight along the line *A'B''* and the various buttocks spots transferred. These points are the positions of the buttock lines when the stern plating is flattened out, and lines may be drawn through these points parallel to the center line. The expanded rail and knuckle lines are then transferred to the half breadth plan by measuring in the sheer plan the distances of the rail and knuckle from the line *A B* on each buttock. These are transferred to the half breadth plan on lines *B'*-1, *B'*-2 *B'*-7, and curves are then drawn through the points so obtained.

Next draw on the expanded stern the lines of the stern frames and transom. The rail and knuckle lines in the half breadth plan are girthed with a flexible batten and the positions of the stern frames and transom are spotted upon it. The points are then transferred to the expanded rail and knuckle line, lines drawn between the points will show the stern frames and transom.

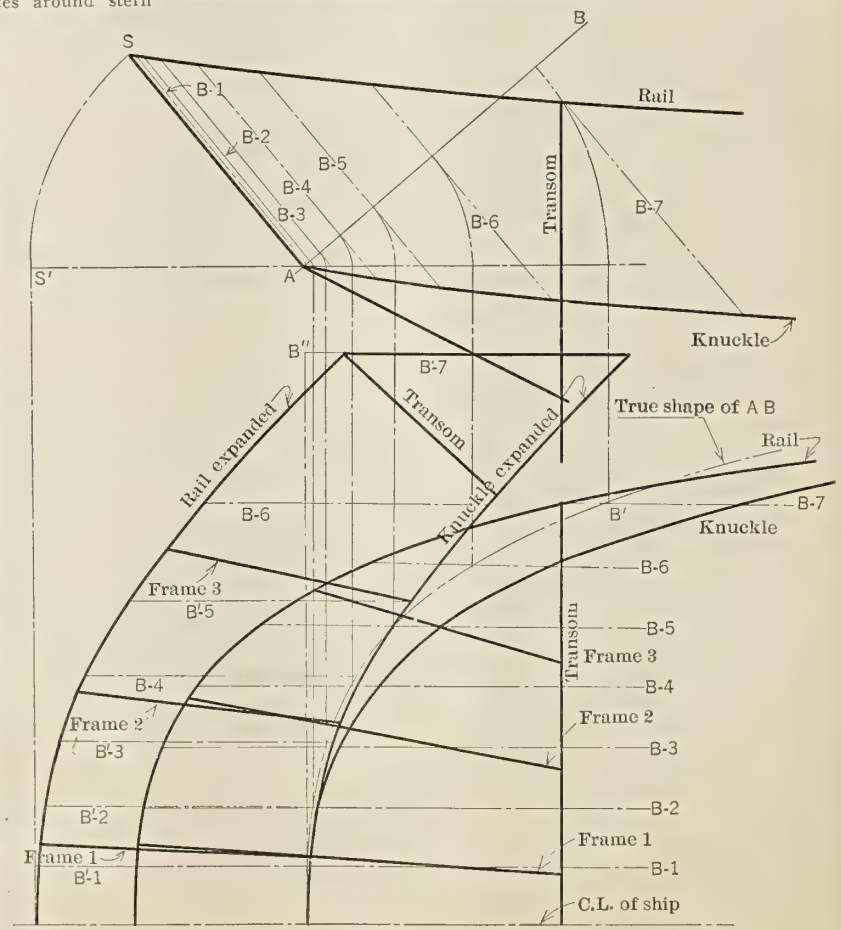


Fig. 1

Having obtained the expanded form of the stern the various plates may be marked off and templates made for each plate. The shape of the plate is such that it is only necessary to roll in one direction.

Size and Weight of Scotch Boiler

Q. (974).—Can you give me rough rules for estimating the size and weight of a Scotch boiler to supply an engine of known indicated horsepower?

A. (974).—An approximate estimate is to allow about 0.52 to 0.59 indicated horsepower per cubic foot of boiler for forced draft conditions and 0.48 to 0.50 indicated horsepower per cubic foot for natural draft conditions. For example, an engine of 1,500 indicated horsepower would need about 1,500 ÷ .59 = 2,540 cubic feet of boiler for a forced draft plant, or a boiler about 16 feet 4 inches diameter by 12 feet length approximately.

The weight of boilers runs about 45 to 50 pounds per cubic foot.

Marine Terminals for Inland River Cities Located on High Ground

(*Concluded from page* 481.)

between the barge and the railway car for interior points. It should therefore be possible to transfer freight directly by machinery from barge to car and from car to barge. To do this there should be railway tracks between the shed and the quay wall, served by the same mechanism which hoists from or lowers into the barge.

As this freight is often for several cities, there should be placement tracks nearby for a number of cars.

Principle No. 3.—There should be direct mechanical co-ordination between water and rail.

The function of the steel shed is short-holding and of the concrete warehouse, long storage. There should be open areas for coarse freight (that which is not affected by the weather) and for bulk material. This coarse freight and bulk material should be transferred by the same mechanism which transfers package freight and miscellaneous goods.

All the cubical contents of the shed and the unshedded areas should be served by overhead machinery which operates in unoccupied air spaces, not requiring floor space to be reserved. Longitudinal movements of freight of every description, even far to the right or left beyond the finished quay wall, can be performed by correctly adapted machines. By such designing the length of the quay wall can be made less.

Conclusions

First: Free vertical freight movements should be possible. The elevation of the bank above the river makes little difference in the time or cost of operation.

Second: Machines of a universal type, capable of transferring any kind of freight, should be provided, whereby the freight can be transferred vertically, the number of machines being proportional to the freight tonnage.

Third: The cost of a terminal quay of modern standard design and facilities for transferring a given tonnage of freight within a given time will require an investment of about one-half than usually required and can be constructed in less than one-half the usual time.

Fourth: The design of the river terminal is an engineering problem, a co-ordination of terminal principles and the adaptation of mechanical appliances.

Fifth: The complete terminal should be constructed by units, that is, each unit with a linear frontage equal to the length of the longest barge. Each unit should be a complete terminal with all the terminal elements and capable by itself of earning a net income on the terminal investment.

NEW BOOKS

Practical Marine Engineering. Sixth Edition. By Rear Admiral C. W. Dyson, U. S. N. Size, 6 by 9 inches. Pages, 1,067. Illustrations, 438. New York, 1918: Aldrich Publishing Company. Price, $6.

In the several editions which have been published since this book was first written in 1901 by Dr. W. F. Durand, at that time professor of naval architecture and marine engineering at Cornell University, numerous changes have been made and much new material added. The fourth edition, published in 1917, was thoroughly revised and brought up to date by Rear Admiral C. W. Dyson, of the Bureau of Steam Engineering, United States Navy. Since the fourth edition was published the United States has entered the war and the demand for trained engineers for operating the great American merchant marine now under construction for the prosecution of the war has been so urgent that it has been found advisable to enlarge this book still further and include information not only regarding the construction, installation and operation of propelling machinery and engine room auxiliaries but also regarding the deck machinery of a merchant vessel. In the new edition a new chapter has been added on miscellaneous machinery, which describes the construction and operation of steering engines, windlasses, boat cranes, anchor engines, ash hoisting engines, towing engines, ventilating, heating and cooling apparatus, sirens and whistles, fire extinguishing and fumigating appliances, reducing valves and regulating valves. The sixth edition of the book, therefore, covers completely every branch of the work within the scope of a licensed marine engineer. It is written with the special object of furnishing aid for applicants for marine engineers' licenses. Questions similar to those given in examinations of applicants for marine engineers' licenses are appended at the end of each chapter, with references to the pages containing the information necessary to answer such questions.

Concrete Engineers' Handbook. By George A. Hool, S. B., and Nathan C. Johnson, M.M.E. Size, 6 by 9 inches. Pages, 885. Numerous illustrations. New York, 1918: McGraw-Hill Book Company, Inc. Price, $5.

This handbook presents in concise form what the authors consider the best of present-day knowledge concerning concrete and reinforced concrete. It contains complete data and details, with numerous tables and diagrams, for the design and construction of the principal types of concrete structures. Owing to the very recent application of concrete to shipbuilding, the only reference to concrete barge and ship construction in the book is a brief extract from a report of the joint committee of the American Concrete Institute and the Portland Cement Association published last fall.

The Strength of Ships. By J. Bertram, A. M. Institute, C. E. Size, 4½ by 7¼ inches. Pages, 290. Illustrations, 114. Tables, 31. New York, 1918: D. Van Nostrand Company. Price, $3 net.

The information given in this book has been drawn largely from the standard works on theory of structures for the principles, formulae and proofs which are essential to a clear understanding of the structural problems in a ship. The theoretical matter is presented in simple language and covers the subject in a general way, in order to give a student or practicing engineer the theoretical ground work for application to special problems.

Shipbuilding and General Marine News

Contracts for New Ships—Shipyard Improvements—Engineering Projects—Improved Appliances—Personal Items

CONTRACTS FOR 61 VESSELS AWARDED BY SHIPPING BOARD

Deadweight Tonnage of Both Steel and Wood Vessels Amounts to 439,800 Tons—Biggest Contract Goes to Pacific Coast Shipbuilder

Contracts for the construction of 61 steel and wooden vessels aggregating 439,800 deadweight tons have been awarded by the Shipping Board during the week ending July 13. Of this tonnage 392,800 tons will consist of steel vessels and the rest of wooden ships.

The largest contract went to the Skinner & Eddy Corporation, Seattle, calling for the construction of 35 steel cargo steamships aggregating 332,800 deadweight tons. The Mobile Shipbuilding Company, Mobile, Ala., received a contract to build 12 steel freighters of a combined tonnage of 60,000, making in all 47 steel vessels provided for in the new contracts.

Contracts for building 14 wooden ships were divided between K. M. Murdock, Jacksonville, Fla., 6 ships of 21,000 tons; the Missouri Valley Bridge & Iron Company, Quantico, Va., 7 ships of 24,500 tons, and the Continental Shipbuilding Corporation, Yonkers, N. Y., 1 vessel of 1,500 tons.

Combustion Engineers Wanted by Oil Division, U. S. Fuel Administration

The Bureau of Oil Conservation, Oil Division, U. S. Fuel Administration, Washington, D. C., is desirous of securing a combustion engineer for each of the following districts, who will act as an inspector, visiting all plants within his district using fuel oil and natural gas: Boston, Providence, New York City, Philadelphia, Pittsburg, Buffalo, Detroit, Chicago, Minneapolis, Tulsa, New Orleans and San Francisco.

It is desirable to have these men act as volunteers where possible, but the Administration is prepared to pay a reasonable compensation for men who cannot afford to give their services to the Government. Only men who have had experience in fuel oil and natural gas combustion would be of value.

British Ship Repair Plants Under One Control

A recent report on the work done in British repair yards which are now coordinated under Government control discloses the fact that in the period from August 3, 1917, when the Control Board was organized, to April 25, 1918, these yards have repaired and restored to service 5,307 vessels, representing an aggregate gross tonnage of 16,150,000 tons. This gives a weekly average for the period of 414,000 gross tons, but the weekly average for some weeks has risen to over 500,000 gross tons, and is steadily increasing.

As much as 2,120,301 gross tons of shipping have been in hand during one week, of which during the week more than half a million tons were restored to service. The amount restored in one week has reached the figure of 598,000 gross tons. Five ships, each of over 20,000 tons, have left the yards ready for service in a single week.

LABOR DAY TO BE ANOTHER RECORD LAUNCHING DAY

American Labor Proposes to Eclipse Fourth of July Launching Records

American labor has proposed to the Shipping Board that Labor Day this year shall be made a second Fourth of July in the launching of a record number of ships to help defeat Germany. Chairman Hurley has referred the proposal to Samuel Gompers, president of American Federation of Labor, who will take up the question with unions on the Pacific Coast, where the suggestion originated, with a view to making the celebration national if it meets general approval.

Pacific Yard Trying to Beat Tuckahoe Record

The Union Iron Works, Alameda, Cal., has started the construction of a 12,000-ton steel freighter with the intention of completing the vessel in 28 days. This is in response to a challenge of the New York Shipbuilding Corporation, Camden, N. J., which launched the 5,000-ton steel freighter *Tuckahoe* 27 days after laying the keel and completing the vessel in 37 days.

Homes to Be Provided for Shipyard Workers on Staten Island

The Housing Department of the Shipping Board has recently decided to erect a large number of houses for shipyard workers on Staten Island. Houses for the accommodation of 30,000 persons have so far been agreed upon.

The five large shipyards on Staten Island, employing about 30,000 workmen, have been seriously handicapped through lack of housing facilities for the workmen's families. Through the efforts of the Merchants' Association of New York the Government has now agreed to provide these necessary facilities and the sites have been decided upon.

THIRTY STEEL CARGO SHIPS TO BE BUILT IN JAPAN FOR SHIPPING BOARD

Japanese Shipbuilders Now Have Contracts for 380,000 Tons of American Shipping—United States Will Supply Steel

Following the conclusion of an arrangement with the Kiangnan Dock & Engine Company, of Shanghai, whereby that company is to build 120,000 tons of steel steamships for the United States Shipping Board, it has been announced that contracts for thirty additional steel cargo steamships had been awarded to Japanese shipyards.

Where the Ships Will Be Built

The yards which have been awarded the contracts and the number of ships which they are to build is as follows:

One cargo ship, Asahi, Osaka, Japan.

One cargo ship, Fujinigata, Osaka, Japan.

Two cargo ships, Harima Company, Aici, Japan.

Two cargo vessels, Ishikawajima, Tokio, Japan.

Five cargo ships, Kawasaki, Kobe, Japan.

One cargo ship, Ritta, Osaka, Japan.

Three cargo vessels, Yokohama, Japan.

Two cargo vessels, Asano, Tsurumi, Japan.

Three cargo vessels, Uraga, Japan.

Two cargo vessels, Mitsue Bussan, Uno, Okayama, Japan.

Two cargo vessels, Mitsubishi, Nagasaki, Japan.

Two cargo vessels, Uchida, Kawasaki, Japan.

Four cargo vessels, Osaka, Japan.

150,000 Tons Already Chartered

The Shipping Board had already chartered 150,000 tons of shipping from Japan and purchased another 127,000 tons. Some of the ships will be equipped with guns and gun crews and put immediately into the overseas service to carry men and supplies to France. Others will be used in the coastwise and South American trades.

Total contracts now let to Japanese shipbuilders provide for 380,000 tons of shipping, including 50 cargo carriers. These will cost approximately $78,000,000, of which about $20,000,000 has been expended. The estimate of the Shipping Board, which was submitted to the Appropriations Committee of the House, asked for an additional $55,000,000 for this purpose. The Shipping Board had also permitted Japan to obtain 100,000 tons of steel plates, and will now provide 35,000 tons for this new construction.

CHINA TO BUILD SHIPS FOR THE UNITED STATES

Contract Let by Shipping Board for Four Cargo Vessels of 10,000 Tons Each

Contracts for the construction of four cargo vessels of 10,000 tons each, and options for the building of 80,000 tons additional, were awarded by the Shipping Board on July 13 to the Chinese Government yard at Shanghai. The vessels will be built by the Kiangnan Dock & Engine Works, Shanghai, whose manager, Mr. R. S. Mauchan, negotiated the contracts as the representative of the Chinese Minister of the Navy, whose department has control of the yard.

Ship Fabricating Steel Plant to Be Built at Birmingham

H. L. Brittain, president of the Mobile Shipbuilding Company, Jacksonville Dry Docks & Repair Company, vice-president of the Terry Shipbuilding Company at Savannah, and several other corporations in New Jersey, closed a deal at Birmingham, Ala., for a 53-acre tract of land upon which will be constructed a mammoth fabricating steel plant, representing an immediate investment of $1,000,000, employing 200 men, to be financed by the Emergency Fleet Corporation for the manufacture of steel plates, shapes and other structural material for ship construction.

Cape Cod Canal Under Government Control

To protect New England's coal supply from Southern ports from the submarine menace the control of the Cape Cod Canal has been taken over by the Government. The canal will be operated by the Railroad Administration.

Turbine Production Controlled by Government

To insure the proper supply of turbines for ships for the navy and the Emergency Fleet Corporation, the Government has assumed control of the turbine engine industry of the country. Manufacturers of turbines under 700 horsepower do not come under Government supervision.

Third Ship Launched by Universal Shipbuilding Company

With the launching of the steamship *Banicaa,* a Ferris type wooden steamer of 3,500 tons deadweight, on July 16, the Universal Shipbuilding Company, Houston, Tex., has so far put into the water three vessels. The fourth was scheduled for launching three weeks later.

E. P. Morse, Jr., Heads New Dry Dock Corporation

E. P. Morse, Jr., formerly associated with his father in the Morse Dry Dock Company, Brooklyn, N. Y., is now head of the National Dry Dock Company, Richmond, Staten Island, N. Y., recently organized to take over some of the repair plants on Staten Island. The company is now bidding for the property of the McAllister Dry Dock & Repair Company, West Brighton, N. Y., which is equipped with a 4,000-ton floating dry dock and three smaller docks.

Associated with Mr. Morse are C. Palmer, A. McManus and E. J. Donegan. Mr. Morse was the designer of the 30,000-ton dry dock at the Morse plant in Brooklyn.

SHIPPING BOARD FINDINGS AFFECTING MARINE ENGINEERS AND AMERICAN STEAMSHIP ASSOCIATION

Rules Agreed Upon at National Marine Conference—Wages, Hours of Labor, Holidays, Subsistence and Other Questions Decided

At the national marine conference held in May, 1918, the following rules, Nos. 3, 4, 7, 10, 12, 13, 14 and 15 had not been agreed upon between the Marine Engineers' Beneficial Association and the American Steamship Association, and accordingly were submitted to the Shipping Board for adjudication. The Shipping Board has made the following findings with respect to these rules:

Rule 3. If, while the vessel is in port, an engineer is required to stay aboard at night after having worked all day and not required to do work not necessary for the safety of the vessel, he shall be paid at the rate of time and a half for the full period of night duty or be given a day off with half pay and six hours' pay at the rate of time and a half. If the engineer is required during such night duty to do any work that is not necessary for the safety of the vessel, he shall be paid at the rate of double time for all such hours' work. If an engineer is required to stay aboard on a Sunday or legal holiday he shall be paid time and a half. For the purpose of these rules the time and a half rate shall be 70 cents, and the double time rate shall be $1. Overtime, when generally referred to, shall be figured at the time and a half rate.

Rule 4. All work done off watch at sea, except that which is necessary for the immediate safety of the vessel, shall be paid for as overtime.

Rule 7. Holidays shall be Sundays, New Year's Day, Fourth of July, Labor Day, Thanksgiving Day and Christmas Day, and shall be observed at all ports.

Rule 10. (It is the opinion of the Shipping Board that during the period of the war the demands of the M. E. B. A., as expressed in Rule 10, should be waived, and that no such rule should be adopted at this time).

Rule 12. Chief engineers shall receive for subsistence allowance $2 per day, assistant engineers $1.50 per day.

Rule 13. Ship's articles shall contain a provision providing for the payment of wages and suitable transportation back to the point where articles were originally signed in the event that the vessel is sold, unless the officer is given a reasonable opportunity immediately to re-ship for the home port at an equal salary.

Rule 14. In the interest of uninterrupted and rapid operation of vessels during the war all grievances of cases arising from the non-observance of these rules should at once be reported to the Shipping Board for adjustment, this provision to hold only during the period of the war. A violation of these rules on the part of a member of this association shall be considered conduct unbecoming a member, and such a member shall be subject to the penalty prescribed by the by-laws.

Rule 15. (It is the opinion of the Shipping Board that the claims advanced in Rule 15 should be waived during the period of the war).

Not Acted Upon by Shipping Board

The following rules of the Marine Engineers' Beneficial Association, Nos. 1, 2, 5, 6, 8, 9 and 11, had been agreed upon between this association and the American Steamship Association and were not submitted to the Shipping Board for adjudication. Accordingly the Shipping Board has taken no action with regard to these rules:

Rule 1. Watch and watch to be maintained on sailing day and at all outside ports at all times. No engineer shall be required or permitted to take charge of a watch upon leaving or immediately after leaving port unless he shall have had at least six hours' off duty within the twelve hours immdiately preceding the time of sailing.

Rule 2. A working day at outside ports, or any port where watches are broken, shall be from 8 A. M. to 5 P. M., during which time one hour shall be allowed for dinner. All work performed in excess of this time after 5 P. M. and up to 8 A. M. shall be considered as overtime. If an engineer is required to perform night service, eight hours of such service shall constitute a day's work. (Provided, however, where there shall be a mutual agreement between the engineers on board relative to their watch this rule shall not apply).

Rule 5. If it is necessary to move a vessel in inside ports between 5 P. M. and 8 A. M., or on Sunday or legal holiday when a vessel arrives from a voyage and anchors, or makes fast to a wharf, to wait for a suitable tide or berth or discharge passengers, or baggage, or receive fuel, the engineers shall continue their regular watches at the option of the chief engineer.

Rule 6. In any case where an assistant engineer is required to perform service in excess of eight hours per day, all such work shall be paid for as overtime at the rate of 70 cents per hour. Chief engineers shall not be entitled to pay for overtime. Overtime shall not be payable unless such service shall have been performed upon the written order of the chief engineer, master, owner or agent of the vessel.

Rule 8. No engineer shall be laid off over a Sunday or holiday, and a full complement of engineers shall be employed at all times while the vessel is working cargo or in commission.

Rule 9. The chief engineer shall be notified at the time of the arrival, or as soon as possible thereafter, of any anticipated detention of the vessel.

Rule 11. Chief engineers shall be employed by the owners, superintending engineers or agent; assistant engineers to be selected by the superintending engineer, owner or agent, after consultation with the chief engineer.

Shipbuilding Contracts

The United States Shipping Board has let contracts which have been distributed among the shipyards of the Atlantic and Pacific coasts for 92 large troopships, which are to be completed before the end of 1919.

The Todd Shipbuilding Company, 15 Whitehall street, New York, has received an order from the United States Shipping Board to build 12 steel steamships, each having a carrying capacity of 7,500 tons. They will be built at the yard of the Dry Dock & Construction Company, Tacoma, Wash., a subsidiary company. It is reported that each of these vessels will have a deadweight tonnage of 10,000.

Order for Pacific Coast

The Columbia River Shipbuilding Company, Portland, Ore., A. F. Smith, president, has received contracts to build fourteen 8,800-ton steel steamships for the United States Shipping Board.

The Portland Shipbuilding Company, South Portland, Me., Edmund R. Norton, president, is building six trawlers for the Bay State Fisheries Company, Boston, Mass.

Five Revenue Cutters Ordered

The Port Huron Foundation Company, Port Huron, Mich., is reported to have received a contract from the United States Coast Guard Service to build five 280-foot revenue cutters.

It is reported that two of the 40,000-ton battleships recently authorized by Congress will be constructed by the Brooklyn Navy Yard.

It is reported that the Mobile Shipbuilding Company, Mobile, Ala., has received a contract from the United States Shipping Board to build twelve 5,000-ton steel steamships.

The Cornwall Construction Company, Tampa, Fla., will build four 3,000-ton wooden freight steamships.

The Pacific Coast Shipbuilding Company, San Francisco, Cal., is reported to have received a contract to build ten 9,400-ton ships for the United States Shipping Board.

Contracts for Japan

The United States Shipping Board, Washington, D. C., has closed contracts with Japanese shipyards for thirty steel steamships to cost about $78,000,000.

The United States Shipping Board is also making arrangements to build twelve or more steel steamships in China. Contracts have already been placed in that country for four ships of 10,000 tons each.

The Newport News Shipbuilding & Dry Dock Company, Newport News, Va., has received a contract to build two more of the large transports to be built for the War Department, and also contracts to build eight oil tankers and several more freight steamships.

The Mobile Shipbuilding Company, Mobile, Ala., W. L. Kelly, president, has received a contract from the Shipping Board to build twelve 5,000-ton steel steamships.

The Sehrs Shipyard, Irondale, Wash., has received a contract to build two wooden steamships for the French Government, and a railway ferry barge 160 feet long.

The Union Bridge & Construction Company, Morgan City, La., has a contract from the Shipping Board to build three barges.

The Standard Shipbuilding Corporation, 44 Whitehall street, New York, José Marimon, president, has leased the Birch Point Shipyard at Wiscasset, Me., where it has a contract to build six ships.

The Machias Ship Construction Company, Bangor, Me., is building two 1,000-ton wooden ships.

The Puget Sound Bridge & Dredging Company, Seattle, Wash., has received a contract from the United States Shipping Board to build a 5,000-ton wooden ship.

Concrete Ship *Faith* at Sea in Storm With Rail Awash

Increased Cost of Ships

Reports show that a vessel recently contracted for, which would have cost before the war $75 to $80 a ton, was built at a cost of $230 to $240 a ton.

Another case was cited of two sister ships built in England, one of which was contracted for in the early stages of the war and completed in February, 1917, and the other completed in May, 1918. The increased cost on the hull was 58 percent for the 1918 steamer as compared with the 1917 vessel, while there was an increase of 206 percent on the machinery.

Sea Breaking Over Deck of Concrete Ship *Faith*

Concrete Ship "Faith" Weathers Heavy Gales Without Mishap

On June 7 the 5,000-ton concrete ship *Faith*, completed at Vancouver her first ocean voyage, which was started from San Francisco on May 22 with 4,300 tons of salt and copper ore. During this voyage the *Faith* encountered very severe storms, some being gales ranging from 40 to 80 miles or more per hour, but she weathered them all successfully, and arrived at her destination without any mishap whatever.

Twenty Troopships to Be Built at Alameda, Cal.

During the week ending July 5 contracts for 20 troopships were awarded to the Bethlehem Shipbuilding Corporation, of Alameda, Cal. During the same period the Shipping Board contracted for the building of three barges, the award going to the Union Bridge & Construction Company, of Morgan City, La.

Henry Penton Appointed General Manager Ninth District

The appointment of Henry Penton as manager of the Ninth District was announced by Vice-President Charles Piez, of the Emergency Fleet Corporation, on July 2. Mr. Penton will be the resident representative of the vice-president's office, and will have supervisory jurisdiction over all phases of ship construction and inspection in his district.

NEW SHIPYARDS AND EXTENSION OF EXISTING YARDS

Additions, Improvements and Orders for New Equipment

The J. H. Price Shipbuilding Corporation has purchased the Standstrom Shipbuilding Company's plant at Seattle, Wash.

The Federal Shipbuilding Company, Kearney, N. J., is said to be planning the construction of a 1,000-foot dry dock.

The Ambursen Construction Company, 51 Broadway, New York, which has received a contract from the United States Shipping Board to build four concrete-steel barges, will build a plant at Little Ferry, N. J.

Government Concrete Shipyard at Mobile

The Emergency Fleet Corporation, Washington, D. C., is reported to have decided to build twelve ways at Mobile, Ala., for the construction of concrete vessels. The Fred T. Ley Company, of Springfield, Mass., and 19 West Forty-fourth street, New York, is stated to have the contract to build this shipyard and also to build eight 7,500-ton concrete ships.

The Atlantic Fish Company, New York, and the Bay State Fisheries Company, Boston, Mass., have organized the Greenpoint Ship Company to acquire the Sterling Shipyard Company, Greenpoint, L. I.

The Hudson Shipbuilding & Repairing Company has been organized, with headquarters at 239 Washington street, Jersey City, N. J.

The United States Shipping Board will erect a shipyard at Somerset, Mass., to be operated by the Crowninshield Shipbuilding Company, South Somerset.

The Traylor Shipbuilding Corporation, Cornwells, Pa., is planning to build a 1,200-foot equipment dock, and contemplates the construction of two 500-foot dry docks.

The Union Shipbuilding Company, Fairfield, Md., a branch of the Riter-Conley Manufacturing Company, Pittsburg, Pa., is planning the construction of two new shipways.

The Crisfield Shipbuilding Company, Crisfield, Md., will enlarge its plant to provide for the building of two steamers and a number of tugboats, contracts for which have been received from the Government.

The Muller Shipbuilding Company has been organized at Los Angeles, Cal., by A. B. Cass, L. Cass, C. G. Lynch, A. M. Leaf and J. E. Shelton.

The Inter-Ocean Barge & Transport Company, Seattle, Wash., G. N. Linemire, president, will build a shipyard for the construction of concrete vessels.

Mammoth Plant for Submarines

The Lake Torpedo Boat Company, Bridgeport, Conn., is understood to have made plans for an extension which will make it the largest plant in the world devoted exclusively to the construction of submarines.

The California Shipbuilding Corporation, Los Angeles, Cal., will build a shipyard in Los Angeles harbor.

Anthony O. Boyle, 1 Broadway, New York, has purchased waterfront property at Greenpoint on which he is planning to build a shipyard.

The American Concrete Pipe & Shipbuilding Company, Seattle, Wash., which is planning to build a concrete shipyard at Lake Washington, states that it will build ten ways which will permit the construction of 10,000-ton concrete ships. W. F. Hallowell is secretary.

The Delta Shipbuilding Company has been organized in New Orleans, La., by Richard B. Stanford, Charles A. Koch and others.

The merger of the Seattle Construction & Dry Dock Company with the Skinner & Eddy Corporation, Seattle, Wash., will result in extensive enlargements and improvements.

The Concrete Ship & Barge Company has been organized in Newark, N. J., by C. M. Sexton, 191 South Clinton street, Jersey City, N. J., and others.

The Standard Shipbuilding Company, 44 Whitehall street, New York, Jose Marimon, president, will make additions to its plant at Shooters Island, Staten Island.

Ford Plant at Kearney, N. J.

Plans have been prepared by the Ford Motor Company, Detroit, Mich., for the construction of a plant at the Passaic River at Kearney, N. J., for the manufacture of submarine chasers.

It is reported that Charles M. Schwab, Director General of the Emergency Fleet Corporation, is planning the construction of a large shipyard on the Philadelphia waterfront.

The West Coast Shipbuilding Company has been organized by C. C. Spicer and A. G. Keating, H. W. Hellman building, Los Angeles, Cal.

It is reported that the Bethlehem Steel Corporation, Bethlehem, Pa., has completed plans for the construction of another shipyard for the Government of the same general type and capacity as that now being constructed at Alameda, Cal. It is said that the new yard, together with its equipment, will cost in the neighborhood of $25,000,000.

The National Dry Dock & Repair Company has been incorporated by C. Palmer and J. A. McManus, 27 William street, New York.

The United States Shipping Board has completed negotiations with the city of San Diego, Cal., for a lease of waterfront for a new shipyard. It is understood that the yard will be constructed by the Schofield Engineering Company, San Francisco.

The United States Shipping Board is planning the construction of a shipyard and dry docks at Norfolk, Va.

The Muller Shipbuilding Company has recently been organized in Los Angeles, Cal., and is said to have completed plans for a shipyard at San Pedro. Luis and A. B. Cass, Los Angeles, are among those said to be interested.

The Brunswick Marine Construction Corporation, Brunswick, Ga., W. U. Taylor, president, is reported to be planning to enlarge its shipyard and equip it for the construction of steel vessels.

The Delta Shipbuilding Company, R. B. Sanford, president, Metropolitan Bank building, New Orleans, La., has acquired a site and will equip the plant to build concrete ships.

O. A. Bloxom, Battery Park, Va., has organized the Bloxom Brothers Shipbuilding Company, for the purpose of building wooden schooners, barges and tugs.

The Terry Shipbuilding Corporation, 70 East Forty-fifth street, New York, is reported to be planning the erection of a shipyard at Hunters Point avenue and Orton street, Long Island City, N. Y.

The Boston & Penobscot Shipbuilding Company has been organized. Among the incorporators are G. H. Lucey, Swampscott, Mass., and W. R. Burhoe, Reading, Mass.

The Fabricated Ship Corporation has been organized in Richmond, Va. A. L. Langley is president, C. P. Royster, vice-president, and R. G. Dashiell, secretary.

The Ogdensburg Shipbuilding Corporation has been incorporated by C. R. Allison, H. L. Andrews and A. M. Skivens, 111 Broadway, New York.

The Inter-Ocean Barge & Transport Company, Seattle, Wash., has completed plans for building a concrete ship plant. The company is reported to have already received a contract to build two concrete ships.

James W. Black and others will, according to report, build a shipyard at Plaquemine, La., with eight ways.

It is reported that A. E. Welsh, of Enfield, Ill., will organize a company to build a shipyard at Tarpon Springs, Fla.

The Slidell Dry Dock & Shipbuilding Corporation has been organized at Slidell, La. Andrew Canulette is manager.

The Transatlantic Shipyards Corporation, 95 Liberty street, New York, has acquired the shipbuilding works at Tottenville, Staten Island, formerly operated by J. S. Ellis & Son.

Rate of Accidents in Shipyards

Complete refutation of the insidious stories recently circulated by German propagandists, to the effect that more men are being killed and injured in our shipyards than are being killed and injured in the trenches, was recently made in a statement from the Industrial Relations Division of the Shipping Board. According to this statement, in spite of considerable additions to most yards and the confusion attendant upon increasing capacity in practically all yards, the rate of accidents in connection with shipbuilding to-day is not as high as that which obtains in the manufacture of steel, and is practically the same as in the general industrial rate. The Department of Labor Statistics show that the accident rate in shipyards from 1912 to 1916 is approximately 21.8 for every thousand men. These figures cover a period previous to the enlarged shipbuilding activities in this country.

At Hog Island during May this year the average force of men employed was 20,897. The number of accidents which caused loss of time was 107, which gives a rate of six for every thousand men, as compared to the rate of 21.8 for the period from 1912 to 1916. This decreasing rate of accidents is due to the very effective work of the Department of Safety Engineering organized by the Emergency Fleet Corporation and also the Department of Health and Sanitation. To-day every district in the country has its competent safety engineer, who is co-operating with the shipyards to keep down the number of accidents and prevent the hazards that are common to any structural industry.

New Compressed Air-Operated Tool for Driving Spikes, Drift Bolts and Pins

The timber in wooden ships, docks and cribs is usually secured with spikes or drift pins driven in place by hand. Where such work is done, compressed air is ordinarily available, for in wood construction, as in steel, a variety of air-operated tools does better work and faster work than can be done by manual labor. The new driver shown in the illustration is operated by compressed air, and will drive in a day, or a shift, more spikes, drift bolts or pins than can be driven by hand and with less physical effort.

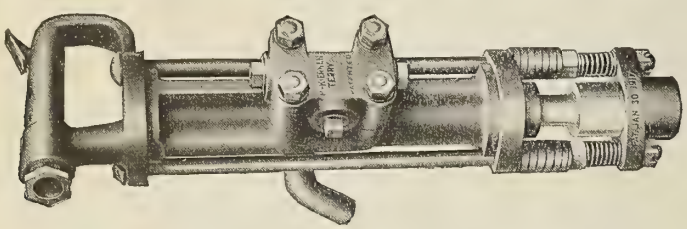
This driver strikes a powerful blow, and will drive drift bolts or pins of the largest size. Owing to its lightness it is easily handled by the operator when driving either in a horizontal or a vertical direction.

If a hand-driven bolt is struck a foul blow it will bend, and if not properly straightened is very difficult to drive. The machine-driven spike or bolt does not bend. The compressed air-operated driver delivers a succession of rapid and powerful blows on the bolt head, forcing it forward quickly and in true alignment with the bolt hole until brought up flush to the surface of the timber.

The spike or bolt is first given two or three blows with a hand hammer to start it into the hole bored to receive it, and is then sent home with the driver.

In a shipyard building wooden vessels one of these drivers drove home inch and a quarter by 28-inch spikes at an average speed of 9 seconds each, which indicates clearly the economy as compared with hand driving.

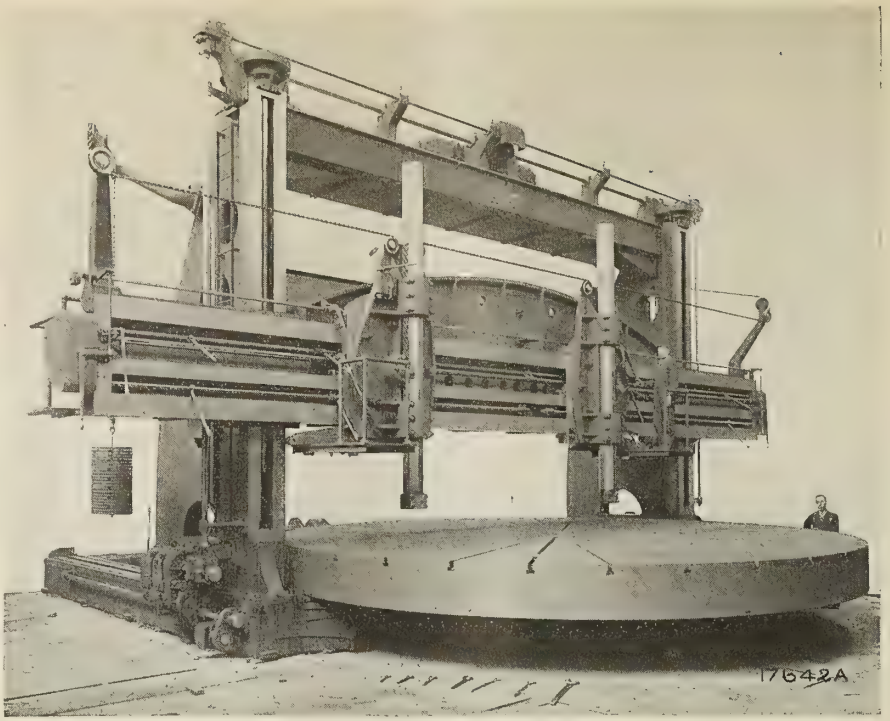
The tool is designed along the lines of a hammer drill, and is controlled by a trigger valve in the handle, which is moved by the thumb of the operator. The top head, cylinder and front head



Pneumatic Tool for Driving Drift Bolts, Spikes and Pins

are held firmly together by side rods, the latter extending below the front head to support a spike-holding socket, which is held away from the front head by spiral springs. By bearing down on the driver handle, the spike-holding socket moves back and over the driving spud, or anvil block, so that the spike, bolt or pin may be driven flush to the surface of the timber. During this operation the position of the driving spud or anvil block in the cylinder is unchanged, so that the full power of the piston's blow on the drift bolt is as great on the last stroke as on the first.

This compressed air-operated driver is 23½ inches long over all, weighs 46 pounds, is of steel throughout, and all wearing parts and surfaces are carefully hardened and ground. It is manufactured by McKiernan-Terry Drill Company, 21 Park Row, New York.



Huge Boring and Turning Mill Built by Niles-Bement-Pond Company for the Government

28- to 42-Foot Extension Boring and Turning Mill Built for Arsenal Work

A 28- to 42-foot extension boring and turning mill was recently built by the Niles-Bement-Pond Company, New York, for arsenal work. The machine swings 28 feet 2 inches with the housings forward, and 42 feet 4 inches with the housings back. The maximum height under the tool holders is 10 feet; the bar travel 84 inches.

The table is driven by a 60-horsepower motor through a double pinion drive. A 25-horsepower motor is used for elevating the cross-rail, and a 15-horsepower motor for fast traversing the bars and saddles. A separate 15-horsepower motor is used for traversing the housings. Push button control is provided for all motors.

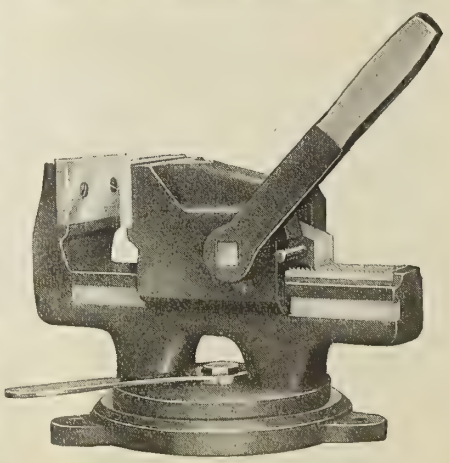
The cross-rail has two heads, with octagon bars 10 inches across the flats. The cross-rail is 48 inches in width and 54 inches in depth from front to back.

The table is designed to carry safely a load of 300,000 pounds in addition to its own weight. The table is driven by two forged steel pinions, one located on each side of the table. The heads on the cross-rail are provided with platforms for the operator. The adjustment of feeds and rapid traverse for bars and saddles is controlled from the platforms. The main driving motor is also controlled from these platforms as well as from stations at each side of the machine.

Winans' New Idea Vise

The Barnett Foundry & Machine Company, Irvington, N. J., has just brought out a machinists' bench vise under the name of "Winans' New Idea Vise" that embodies many novel features. Reference to the illustration will point out its general characteristics. It will be seen that the old-fashioned screw and lever has been replaced by a pawl and rack. This is actuated by a handle on an eccentric shaft, which will exert a pressure many times that possible with a screw.

The adjustments from 0 to maximum are made instantly with one sliding movement. The pawl eccentric and sliding jaw form a toggle joint, bringing the greatest pressure to bear on the top part of the jaws, causing the work to be clamped tightest at the working part. The moving member of the vise slides away from the operator, and there is no



Bench Vise of Novel Design

handle between operator and the vise. The gripping plates are hardened and ground, and the rack and pawl are also hardened steel.

A feature of especial importance is that the whole vise may be removed from its swivel base and taken to surface plate, drill press or milling machine for continuous operations, since the base of the vise is accurately machined to right angles with the jaws.

These vises are made in standard sizes of jaws from 3 inches to 8½ inches, and openings of 3½ inches to 12 inches.

Multiwhirl Cooler

In these days of large marine turbines it is imperative that the lubricating oil supplied to the bearings is of correct temperature to maintain an oil film of proper viscosity between the bearing surfaces. The most efficient means of accomplishing this result is by cooling the lubricating oil to the proper temperature. This also permits the continued use of a given quantity of oil.

The subject of oil cooling is quite complex, in that the variables encountered, which determine the transfer surface for any given form of cooler, depend not only on the character of the oil, the inlet and outlet temperatures of the oil, the inlet temperature of the water and the quantity ratio of oil and water, but also materially on the temperature level or the portion of the temperature viscosity curve through which the cooling is to take place. The viscosity of the oil plays an important part, inasmuch as the necessary transfer surface varies with it.

The engineering and designing staffs of The Griscom-Russell Company, New York, after years of experience with many forms of heat transfer apparatus, developed the multiwhirl cooler shown in the accompanying illustrations. This period of development was followed by a series of tests to determine the proper ratings, pressure losses, etc., for various grades of oil. The results secured were far beyond expectations, the heat transfer being greater than has been secured in any previous form of commercial oil cooler and the pressure losses correspondingly lower.

Fig. 1 shows a sectional view of the multiwhirl cooler. The shell is of close-grain cast iron. The cooling surface consists of small diameter smooth bore, straight copper or brass tubes, expanded into tube plates without the use of any glands or packing. One tube sheet is bolted solidly to the shell and the other is bolted to a floating head, which permits of expansion and contraction of the tubes without strain on joints. The entire tube bundle and baffle are removable from the shell for inspection without breaking any of the oil connections. This also facilitates cleaning should same become necessary. Fig. 2 shows the tube bundle and baffle withdrawn from the shell.

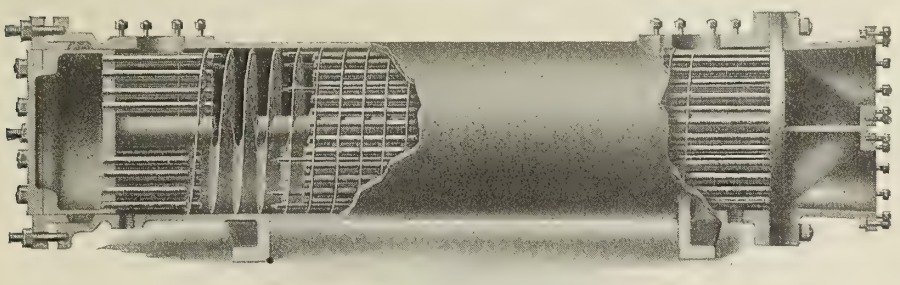


Fig. 1.—Sectional View Multiwhirl Cooler

The baffle is made of sheet iron perforated to permit the insertion of cooling tubes. Spacer rods are located near the circumference of the baffle to insure rigidity and maintain an equal cross section of flow for the oil throughout its entire path. By the use of this form of baffle a maximum length of oil path is secured for a given amount of cooling surface and length of shell. The oil pressure loss is a minimum, because the baffle directs the flow of oil without appreciably retarding its progress. In operation the lubricating oil is constantly circulated through the shell by pump pressure, and is brought into intimate contact with the cooling surface by means of the helical baffle.

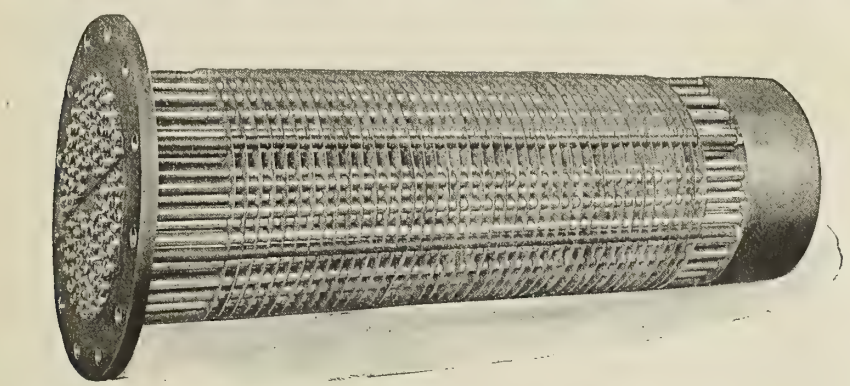


Fig. 2.—Tube Bundle and Baffle

New Pressure Governor for Gas and Liquid Systems

In many power installations, where air, other gases or liquids must be maintained under pressure, the demand for an automatic method of doing this has arisen. As a result, the General Electric Company, Schenectady, N. Y., has developed a new pressure governor to control standard self-starters for motor-operated pumps and compressors. The governor maintains a pressure between predetermined limits on any gas or liquid systems that will not corrode the Bourdon tube.

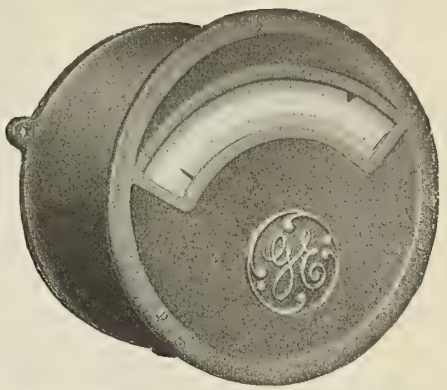


Fig. 1.—Contact Making Pressure Governor

This governor is called the CR 2,922, and can be used on any standard A. C.

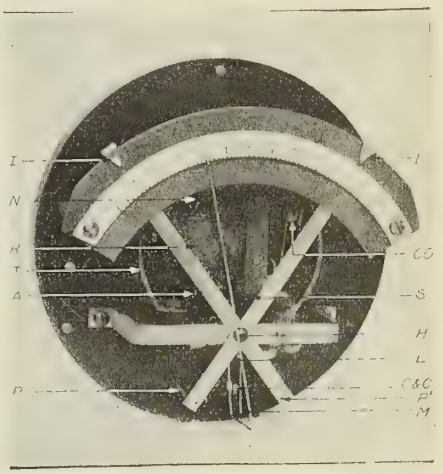


Fig. 2.—Internal Mechanism of Pressure Governor

of 80, 100, 160, 300, or 500 pounds, and operates within settings of from 3 to 12 pounds between high and low pressures. Governors for higher pressures can be supplied if desired.

The governor consists of a Bourdon tube, an indicating needle, a graduated pressure scale, adjustable high and low pressure stops to determine the desired pressure range, and a relay which actuates the contacts in the control circuit of the self-starter, all enclosed within a dust-proof case, easily opened for inspection.

Action of the governor is dependent on the Bourdon tube, which should be connected to an independent discharge pipe from the pressure tank. The free end of the tube *T* (Fig. 2) is mechanically connected to the indicator needle *N*,

moving it over the scale as changes of pressure affect the tube.

After the settings for the pressure range have been made, the governor will automatically maintain pressure within those limits. The operation of the pressure governor is as follows:

Assuming that the pressure is at the low value, as indicated by the left-hand indicator *I*, the contact *C* on the needle *N* completes the circuit through the contact *C'* on the movable arm *M*, which at low pressure point rests against the stop *P*. When this contact is made, the circuit is completed through the relay coil *R*, causing the armature *A* to close. Attached to this is the contact *CO*, which upon closing completes the control circuit to the self-starter, causing the motor to start.

The armature is also attached to the spring *S*, which holds the contact *C* firmly against *C'* until contact is broken at *P*.

As the pressure increases the needle pointer moves to the right, but its lower part, to which the contact *C* is attached, moves to the left, and is followed by the movable arm *M*. When the high pressure point is reached the movable arm is prevented from traveling further by stop *P*, and the needle continues its course, breaking the circuit by separating contacts *C* and *C'*. The instant the circuit is broken the relay *R* is de-energized, its armature falls, releasing the tension of the spring *S*, and because the movable arm *M* is counterweighted it returns to the stop post *P*.

When the pressure is decreased to the minimum value, the contact *C* again completes the relay coil circuit by engaging contact *C'*, and the cycle of operation is repeated.

The case is tapped and drilled at the bottom for the pressure pipe and electrical conduit connections.

No Immediate Shortage of Engineer Officers

Agents of the United States Shipping Board Sea Service Bureau from Atlantic, Gulf, Pacific and Great Lakes ports, in conference June 26, 27 and 28 at national headquarters of the Shipping Board Recruiting Service at Boston, saw no probable shortage of engineer officers any time in the next few months. A country-wide canvass showed that 90 percent of marine engineers now employed ashore in responsible positions are willing and anxious to return to the sea the moment the Government needs them. Supplementing the large number of marine engineers who are being trained in the Shipping Board free schools, the licensed officers now in shore positions form a reserve that should result in no ships being kept from moving because of a lack of chief or assistant engineers.

The conference resulted in numerous problems pertaining to the better manning of the merchant marine being solved.

Thursday the agents went out into Massachusetts Bay on the training ship *Calvin Austin* to see merchant marine apprentices in actual training under the Shipping Board. That evening they tendered a dinner at the Harvard Club, where there were addresses by Henry Howard, director of the Shipping Board Recruiting Service; Edward F. Flynn, assistant to the director; Capt. Eugene E. O'Donnell, of Boston, and others.

Those attending the conference included Edward C. Hovey, Jr., Cleveland Bigelow and Harrington Pike, of Boston; Russell Patterson, New York; William G. Rice and James Thompson, Philadelphia; Capt. John W. Inglesby, Newport News; J. W. Lindau, Baltimore; Frank W. Spencer, Savannah; Philip A. Shore, Tampa; Capt. Ernest E. B. Drake, New Orleans; Capt. John Leale, San Francisco; E. J. Griffith, Seattle; Capt. Irving L. Evans, Cleveland, and James L. Ferguson, Charleston.

New Canadian Yard to Build Ships for France

A new shipbuilding syndicate, capitalized at $5,000,000, has been organized to operate a large shipyard on the St. Lawrence River opposite Quebec City. This syndicate comprises the Victoria Shipbuilding Company, of Sarnia; the Dominion Shipbuilding Company, of Collinwood; Dussault & Hutchison, of Levis, and a number of old French capital interests. This firm will build steel vessels for the French Government.

PERSONAL

Luther D. Lovekin, formerly chief engineer of the New York Shipbuilding Corporation, Camden, N. J., has been elected a vice-president of the American International Shipbuilding Corporation, Hog Island, Philadelphia. Since the construction of the Hog Island yard was begun, Mr. Lovekin has served as consulting engineer of the American International Shipbuilding Corporation.

J. H. Rosseter, vice-president and general manager of the Pacific Mail Steamship Company, San Francisco, Cal., has been appointed director of the Department of Operations, United States Shipping Board Emergency Fleet Corporation, vice Edward F. Carry, who has resigned to become chairman of the Port and Harbor Commission.

Rear Admiral Francis T. Bowles, assistant general manager of the United States Shipping Board Emergency Fleet Corporation, formerly in charge for the Government of the shipyards on Hog Island and Bristol, Pa., has been given complete charge of all the shipyards included in the tenth shipbuilding district of the Emergency Fleet Corporation, which includes all the yards on the Delaware River.

E. B. Schock, naval architect, Seattle, Wash., formerly of New York City, has accepted the position of naval architect with the Anderson Shipbuilding Company, Houghton, Wash.

E. T. Sederholm, of Pomona, Cal., has been appointed mechanical engineer to the Cleveland district of the Emergency Fleet Corporation, with headquarters in the Perry-Payne building, Cleveland, Ohio.

J. Harry Mull, vice-president and general manager of William Cramp & Sons Ship & Engine Building Company, Philadelphia, has been elected president of the company, succeeding Henry W. Hand, resigned. Mr. Mull is one of the veterans of the Cramp Company, having been associated with it since 1880. He has held successively the offices of general superintendent, manager of the marine department, and more recently vice-president and general manager.

Carl W. Haefner, formerly of the Turner Construction Company, has become associated with Fay, Spofford & Thorndike, consulting engineers, Boston, in the construction of the new Government shipping terminal at South Boston.

Charles H. Crowell, district supervisor of the Emergency Fleet Corporation, Houston, Tex., has been appointed manager of the Stonington (Conn.) Shipbuilding Company.

Alex Maitland has been appointed district supervisor of the Emergency Fleet Corporation, Houston, Tex., vice Charles H. Crowell, resigned.

Eads Johnson, formerly in charge of the New York City office of the Emergency Fleet Corporation, has incorporated a firm in New York under the name of Marine Architects & Engineers, capitalized at $75,000. The other incorporators are A. Collins and J. T. McGovern.

Robert S. Moore, president of the Moore Shipbuilding Company, Oakland, Cal., has retired from active service, becoming chairman of the board of directors. Mr. Moore is succeeded by George A. Armes.

John Pudz has resigned as district auditor of the Emergency Fleet Corporation at Seattle, Wash., to become assistant general manager and comptroller of J. S. Duthie & Company, of Seattle.

Sir Thomas L. Devitt, Bart., was re-elected chairman of Lloyd's Register of Shipping at its recent annual meeting, and Sir Edward E. Cooper was re-elected deputy chairman. Sir Thomas J. Storey was also elected chairman of the classification committee.

W. H. Callan, general manager of plants, and W. P. Pressinger, manager of sales, have been elected vice-presidents of the Chicago Pneumatic Tool Company, Chicago, Ill.

P. B. Findley, technical editor, Department of Publicity, Westinghouse Electric & Manufacturing Company, has resigned to enter the training school at the University of Pittsburg for a special counsel in radio work with the United States Signal Corps.

Theodore Brent, traffic expert with the Fuel Administration, and former member of the Shipping Board, has been appointed traffic manager of the Mississippi River Barge Line.

H. A. Schultz has been appointed executive head of the Safety Engineering Section of the Industrial Relations Group of the Emergency Fleet Corporation.

R. W. Leatherbee has been appointed general supervisor of the District Representatives of the Industrial Relations Group of the Emergency Fleet Corporation.

OBITUARY

Charles Mallory, retired, formerly vice-president of the Mallory Steamship Company, New York, and a son of the founder of the line, died at his home in Port Chester, N. Y., on July 8, aged 74.

Robert S. Armstrong, of New York, fabricating engineer for the Carolina Shipbuilding Corporation, died suddenly of apoplexy in Wilmington, N. C., on July 16.